ORKUSTOFNUN
Raforkudeild

GNÚPVERJAVIRKJUN

GEOLOGICAL REPORT

by

Sveinn Þorgrímsson

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF EXHIBITS

Chapter 1

Introduction

The report discusses the geology of the project sites for power plants in Upper Þjósá, below Norðlingaalda storage reservoir site. The project area is roughly bounded on the north by the river Kisa and to the south by Gljúfurá.
Exh. 1 illustrates the location of the study area within Iceland.

More detailed geologic studies have mainly concentrated in two sections of the area, i.e. the power house site in Gljúfurleit and the diversion canal route between there and Norðlingaalda.

So far little has been written on the geology of this area, but certain sections have been discussed in two separate reports, in one, by Mr. G. Kjartansson geologist: "Geological Studies of the Watershed of Thjorsá during the summer of 1953", dam sites on rivers Kisa, Miklilækur and Dalsá and a tunnel below Öræfahnúkur are briefly discussed. Another report : "Engineering Geology of the Hvítá and Thjórsá Basins, Iceland", written by Allen U. Nicol, was sponsored by the United Nations Special Fund. It a.o. discusses dam sites at the waterfalls Dynkur, Hvanngiljafoss and Gljúfurleitarfoss.

In summer 1966 a geologic survey of the area was conducted by Þ. Einarsson geologist. The result of this survey has not been published on print, but Mr. Einarsson has given me valuable information on the investigations.

In autumn 1970 systematic field and subsurface explorations of the area were initiated by Orkustofnun (National Energy Authority). At Gljúfurleit two core boreholes were drilled, GS-9 (240.5 m deep) and GS-10 (225 m deep) with the main purpose of exploring the character and thickness of the rock units and correlating them with previously measured profiles. Furthermore it was proposed to measure the permeability of the rock units and the ground water level.

On the proposed diversion canal route 813 borro soundings were drilled totalling 1724 m. The purpose was to explore the thickness and nature of the overburden.

In conjunction with the drilling the whole of the area was mapped geologically; the mapping was finished in summer 1971.

Besides the above investigations a fairly comprehensive study of the overburden was accomplished in summer 1971, comprising on one hand the searching for the investigating of construction materials and on the other that of the composition and mechanical tests of the soil on the canal route. These investigations were supervised by Verkfræðiþjónusta Dr. Gunnars Sigurðssonar and will not be discussed further in this report.

The maps used for the geologic mapping were at a scale of 1 : 20.000 furnished by Orkustofnun with 5 m contour intervals. For a restricted area aroung Geldingaá river a map with 1 m contours supplied by Landsvirkjun at a scale of 1 : 5.000 was used.

For the study of tectonic lineations and the general mapping ample use was made of aerial photos furnished by Landmælingar Íslands.

Measuring the dip of the bedrock strata is subject to various difficulties, mainly due to the presence of thick sedimentary layers which cause frequent unconformities of considerable extent and also because most openings occur in the same direction. In order to determine the dip two profiles in Búðarháls were measured facing Geldingaá and Gljúfurá rivers.

Intercorrelating between profiles and observation localities was performed by the "isohypse method".

Chapter 2

Geography

The Þjórsá river and the valley it occupies are the outstanding features of the landscape of the project area. The river is glacier fed deriving the main part of its flow from the SE part of Hofsjökull ice sheet.

The river flows south-west with the project area lying for the most part to the west of it. On the northern border of the area Þjórsá is at somewhat above 535 m elevation, but at the southern border at about 300 m. At Gljúfurleit the useable head is about 220-240 m about half of it occurring in three waterfalls, Hvanngiljafoss, Dynk and Gljúfurleitarfoss, counted upstream.

The discharge of Þjórsá at the confluence with Svartá is about 100 kl/sec., but at the southern limit of the area about 120 kl/sec. The increase in discharge is mainly due to the tributaries Kisa and Dalsá while the other streams joining Þjórsá are Miklilækur, Bjarnalækur, Hölkná, Geldingaá, Gljúfurá, Fosskvísl and various smaller rivulets. All these streams are of the "dragá" type, only Kisa has recurrently some glacier river characteristics.

Above Dynkur waterfall the landscape is rather flat and vegetated as far upstream as Kisa, but north of it gravel plains are the most prominent feature.
The vegetated tracts of land for the most part are semi-tundra or wet bogs, but change to generally dry moor away from Þjórsá.

From the flat ground there rise some low undulating ridges or hills the largest of which are Norðlingaalda, Flóamannaalda, Kjálkaversalda and Öræfahnúkur.

From Dynkur upstream to below Geldingaá Þjórsá has cut a faily deep gorge into the valley bottom. In this reach the river has greatest head or about 145 m.
The Þjórsá valley is vegetated to 575 m elevation while higher up there are low morainic hills and ridges. In between are roches moutoneés, moraines and sandy hills. The vegetation is a dry type except in very restricted areas at Hölkná.
The bedrock in the area is generally covered by overburden, yet good outcrops are rather common, e.g. in the Þjórsá gorge and along the courses of the major tributaries.

Chapter 3

Stratigraphy

In geological respects the area between Hvítá in the west and Kaldakvísl in the east is a flexure. The break axis is near Stóra-Laxá and strikes SSW-NNE. The oldest layers are late Tertiary in age, but most of the layers are formed during the Quaternary. The dip of the oldest strata is about 5°, but decreases constantly with the younger strata. The rock series is composed of volcanic and sedimentary rock in fairly equal proportions. The volcanic rock consists of lava flows from interglacial periods and móberg from glacial periods alternately. A collective name for all the rocks is "Hreppar series".

The late Tertiary rock in the lowlands is overlain by rock series dating from the early Pleistocene, the Grey Basalt Formation. This series forms the bedrock as far inland as Hvanngiljafoss in Þjórsá. On top of these rocks are strata belonging to the Móberg formation (the Young Grey Basalts), which is considered to extend into the Present.

The stratigraphy of the bedrock of the project area comprises the upper part of the Hreppar series or more precisely the time period from the Gilsá event up to the Brunhes epoch (Exh. 2).

Exh. 4 is a general geological map of the area. It is based on more than 20 measured profiles, two boreholes in Gljúfurleit and a great number of observation points. Their correlation was accomplished by analysis of hand specimens.

Exh. 5 and 6 present 11 profiles and Exh. 8 and 9 drillhole analyses of GS-9 and GS-10, the core boreholes in Gljúfurleit. Exh. 10 shows the classification into groups and correlation of some characteristic sections with correlations between glacial horizons and magnetic epochs.

For the sake of convenience the rock series are divided into groups, which are as follows, in chronological order, the oldest being given first.

1. Gljúfurleit group
2. Dynkur group
3. Dalsá group
4. Svartá group

1. Gljúfurleit group

The oldest rock in the area is basalt with normal magnetism appearing at the base of Geldingaá. According to the scale of magnetic epochs this layer belongs to the Gilsá magnetic epoch, being 1.6 million years old. This layer is overlain by dense móberg on top of which is coarse clayish conglomerate more than 10 m thick, which is almost certainly tillite (see Gljúfurá Exh. 5 profile A). The móberg is volcanic rock probably belonging to the earliest glacial epoch, "Gljúfurá I", together with the tillite. About 40 m higher up is another layer of clayish conglomerate, which in a few localities has clear tillite characteristics (e.g. in Gljúfurá). This could indicate a minor glacial advance, "Gljúfurá II". It is very difficult to determine whether the various glacial remains are the remnants of whole ice ages or only those of local glaciers which advance during minor cold climatic periods. It has therefore become an established custom to speak of "glaciations" in these cases without further definition.

On top of Gljúfurá II there follows a 20-40 m pile of strata consisting of 2-6 dark basalt layers followed by sedimentary rock which is about 60 m thick in Geldingaá and reaches a maximum thickness of 80 m.

The lowest 8-12 m of sediments consists of conglomerate with fairly large pebbles but medium sandy groundmass. The next 30 m is fine sandy rock, mostly of tuff and silt somewhat similar to varved clay as it is often regularly layered. The silt layers which are grey-white do not always form continuous horizontal layers, but appear as lenses in red-brownish tuff sandstone. The density of the silt increases upwards indicating increasing effects of glacial water on the formation of the sediments.

Overlying this is 200 m of conglomerate somewhat similar to that, which is at the bottom of the sediments. In the upper part of the conglomerate there is a rather rapid gradation into tillite, which forms the uppermost 10 m of the sedimentary rock.

The lower part of the sediment formation is intruded by large wedges of móberg. The largest continuous extent of móberg occurs in Gljúfurleit between Gljúfurá river and Geldingaá river and is 60 m thick and over 2 km in length. It seems that the móberg was formed simultaneously with the oldest part of the sandstone. The móberg formation is rather varied in nature, consisting mostly of breccia, varying between tuff and pillow breccia.

Cube-jointed basalt commonly occurs mostly near the base in relatively restricted areas. In the east bank of Þjórsá the sediments could nowhere be found, except on a small scale below the móberg formation, which is here of similar thickness to the thickest part in the west bank. A móberg mountain obviously exists here, probably a ridge as the formation can be followed for at least 10 km distance. The móberg occurring in Gljúfurleit is located near the western margin of the mountain, which has a SW-NE trend and for the most part is buried below Búðarháls. The glaciation during which the móberg mountain and the tillite were formed are here termed "Geldingaá". On top of the Geldingaá tillite and flanking the móberg in Gljúfurleit is a porphyritic gray-basalt layer somewhat less than 10 m thick. The magnetic polarity of the layer is very weak and sometimes showed normal (70%) sometimes reverse (30%) magnetism. Obviously magnetic polarity reversal is evident, indicating that the middle part of Matuyama is ending and Javamillo beginning.

Very low in the Gljúfurleit group, below 350 m elevation, but considerably higher up in the borholes, there appear amygdales in a fairly great degree. They are especially conspicuous in the scoraceous collars of the lavas and in tuffaceous sandstone. In winter 1970 refraction measurements of amygdales were performed, they proved mainly to be chabasite with tomosonit also occurring.

At the same depth and even higher up brownish amygdales commonly occur in the scoria which in many ways is similar to old glacial clay, but is much harder. In all fractures and cavities yellow-brownish glacial clay is present. In a few places in pillow breccia in GS-10 and in tuffaceous sandstone in GS-9 the clay is dark green and frequently almost black. X-ray analysis of the clay showed that the dark clay is partly montmorillonit, while the light one is slightly or unaltered glacial clay, mostly basaltic glass.

According to studies of the equilibrium of "Zeolites" the formation of chabasits and tomsonits begins at 35°C at about 360 m dept, but they disappear at 100°C at about 800 m depth. The equilitrium is mainly dependent on the temperature.

If the precipitations are to be interpreted in the same way as has been done in East Iceland then there has been at the time of precipitation a 350-800 m pile of strata on top of them during formation. This means that in Gljúfurleit there was at least 700 m high ground, i.e. 50-100 m higher than the highest parts of Búdarháls at present. If this assumption is correct, the age of "Þjórsárdalur" valley is almost definitely less than Matuyama.

2. Dynkur group

At the waterfall Dynkur there appears a very conspicuous tillite horizon about 10 m thick. The tillite is generally appreciably thinner and is only 2 m at Geldingaá. There it is overlain by 8 m of sand and siltstone, but with 2 m of finegrained conglomerate on top. The sedimentary rock is everywhere layered and partly cross-bedded, indicating that it was deposited in running water.

The oldest rock formation on the damsite at Norðlingaalda is Norðlingaalda itself, which is a contemporaneous formation to the tillite at Dynkur. Norðlingaalda consists of volcanic móberg rather varied in structure consisting of pillow lava, tuff and breccia with considerable basaltic intrusions, often forming a curious mixture of breccia and cube-jointed basalt. Such examples are found very widely on the Norðlingaalda and are easily mistaken for lava. (Exh. 8).

The glaciation during which the Norðlingaalda and the tillite at Dynkur were formed is termed "Dynkur".

The basalt layers of the Dynkur group are 2-4, totalling 40 m in thickness. This is very sound basaltic rock, with small phenocrysts.

3. Dalsá group

Roughly, the Dalsá group includes the rock series of the youngest part of Matuyama extending as far as Miklilækur. Characteristic for this group are highly porphyritic layers of grey basalt and a prominent sediment formation, the Hvanngil sediments.

The oldest rock of the group is sedimentary rock, very tuffaceous sandstone at the base, but on top conglomerate. At Þjórsá considerable unconformity occurs between this sedimentary rock and porphyritic grey basalt, which overlies it. The grey basalt thickens very quickly to the NE upstream and there fills up an old erosion channel which traverses the river. Such unconformities are rather common on the project area. Higher up in the Dalsá group there occurs another uncomformity and at this locality the Hvanngil sediments lie discordant on the older series. The porphyritic basalt is all very homogeneous in structure, with phenocrysts of feldspar and olivine. The phenocrysts are all of similar size $\lesssim 4\ mm^2$, which makes it almost impossible to distinguish the layers from each other by means of hand specimens. The porphyritic layers are shown on the geologic map

by a special symbol. The Kóngsás is underlain by pillow breccia, which becomes thicker towards the north and must reach about 40 m in thickness if the layer is considered to be horizontal at its base level. However this seems highly unlikely as the average thickness of the layer hardly exceeds 15 m. The breccia seems to be rather homogeneous, but at Dalsá it can be seen to be pervaded by rather extensive basaltic veins, radially-jointed basalt and cube-jointed basalt.
The breccia is obviously volcanic móberg the, basalt being probably an injection of the same magma. It seems most reasonable to connect this volcanic formation with a glaciation in some way or other occurring very late in Matuyama, it could be termed "Dals" glaciation. However the distribution and the location of the layer indicate the contrary; rather that this could be a lava flow which flowed into a lake as it is in most cases underlain by a sedimentary layer of varying thickness, sandstone and fine conglomerate. The fine texture of the breccia indicating that the rock was formed below water weakens this theory somewhat.

Hvanngil sedimentary rocks

At Hvanngiljafoss is a voluminous sedimentary layer termed Hvanngil Sediments (H.S.). The layer lies discordantly on the underlying basalt. The lowest 4-10 m is bouldery rock with comparatively fine ground mass. This rock has all the characteristics of tillite, highly variable grain size ranging from boulders of 2 m diameter to silt in the ground mass. The rock is generally loose and often badly consolidated. No layering can be observed.

Above the tillite is conglomerate with pebbles of 3-5 cm diameter and groundmass of tuff. The grain size of the rock becomes gradually finer until the rock has graded into coarse and medium coarse sandstone with small pebbles and bands of small pebbles in between. The rock remains like that to the top with minor exceptions. Layering in the conglomerate and sandstone is clear and the cross-bedding observable in it indicates deposition in running water.

The distribution of the Hvanngil sediments is enormous, e.g. it underlies the entire damsite at Norðlingaalda. Yet, its distribution in Loðnaver is harder to determine, partly because openings are rare and the H.S. is flanked by minor sediments of similar appearance and nature.

With regard to the interpretation of openings on the geologic map it can be stated that all these sedimentary layers are continous.

The Hvanngil sediments have always been interpreted as an interglacial formation as plant remains of Quaternary flora have been discovered there.

The more fine-grained part of the sediments is undoubtedly an interglacial formation, at least for the most part, while it is doubtless that the lowest meters are tillite. This glaciation is here termed "Loðnuver", reserving the "Hvanngiljafoss" name for the interglacial warm climatic period following, but it is not the interglacial subsequent to the "Dynkur" glaciation any longer.

4. Svartá group

To this group belong the youngest rock formations in the area. They were formed during the Brunhes epoch or within the last 0.7 million years (see Exh. 10).

Between Kisa and Miklilækur is Kjálkaversalda, a móberg ridge, mostly consisting of móberg breccia and cube-jointed basalt. Similar rock is also found in Digraalda and Flóamannaalda. Most likely the same rock formation is to be found here forming a continuous unity. This is a móberg mountain, formed during the third latest glaciation, here termed "Flóamannaalda". The formation reaches greatest thickness in Flóamannaalda, about 50 m. It dips away from the alda towards east in the direction of Þjórsá. The elevation difference between its base in Flóamanna-alda and Kjálkaversalda is 100 m. The thickness of the móberg formation in Digraalda and Kjálkaversalda is almost impossible to state as the ridges are covered with moraine.

The basalt north of Miklilækur is probably the oldest rock formation from the Brunhes epoch. This rock is generally very sound, regularly jointed, but everywhere rather thin and often dissected by erosion. The distribution of the layer is not clear, but it extends to just above Kisa, where it is flanked and buried by the Þjórsá basalt.

Also belonging to this group is the Þjórsá basalt and other rock formations on the damsite at Norðlingaalda*). The Þjórsár basalt is a porphyritic basalt rather

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*) Norðlingaalda Geological Report by H. Tómasson and S. Thorgrímsson Jan. 1972.

variable in structure ranging from areas of sound basalt to broken breccia. This basalt has flowed down an older and broader channel of Þjórsá as an inter-canyon lava flow. Owing to wet ground below the lava magma frequently splundered by rapid cooling and formed móberg, either tuff or pillow breccia, but comparatively sound but thin lava layer or cube - jointed basalt on top.

Other rock strata of the Svartá group will not be discussed here.

The geology of each particular site will be discussed further in chapter 6 on Engineering Geology.

Chapter 4

Superficial deposits

At the end of the Glacial epoch the ice sheet of the last glacial began to retreat to the interior highlands. In the project area there are various marks of this retreat.

The main features of glaciation are roches moutonnees, striations, fluations, moraines and drumlins.

The direction of some striae and roches moutonnees are shown on the geological map and the distribution of finiglacial sediments is indicated in the map of superficial deposits. The evidence of the glacial features indicates a two way direction of movement of ice, which are in Gljúfurleit : N 20 - 30°E and N 50 - 60°E, the latter appearing to be the younger.

In Flóamannaalda are found the largest drumlins in the whole area running N 60°E. In Gljúfurleit the trend of the drumlins is similar or N 55°E. This indicates that the drumlins are a contemporaneous formation with the younger glacial striations

Approaching Norðlingaalda the pattern is considerably altered; fluted moraine surface and drumlins are most conspienous. These remains indicate an ESE-WNW trend for the retreating ice sheet.

When retreating from the area the glacier at first had the trend N 20 - 30°E in Gljúfurleit. At this time the main axis of divide on the ice sheet was on the eastern part of Hofsjökull.

The main axis of the ice sheet then moved east creating a N 40°E trending striation system at Norðlingaalda and later a N 50 - 60°E trending system in Gljúfurleit. At the present time the divide is near Tungnafellsjökull or between it and Köldukvíslarjökull.

As the ice margin has retreated to Norðlingaalda the main axis has moved still farther east or near Tungnaárjökull.

From the alterations in direction of movement and the east and east-southeast striking striations at Norðlingaalda it can be concluded that the main ice sheet melted from the water divide on Sprengisandur and Kjölur sooner than from the highlands to the south of it.

The snow-line has probabely been considerably higher up than the water divide while a thick unmelted ice sheet was still covering the lower lying ground of the lower lying ground of the interior highland plateau to the south. The glacier has been thickest at this location and therefore remained there longer than elsewhere.

Loose, superficial deposits forming the overburden are derived from various scources. The main types are vegetated tracts, moraine, sand-filled depressions, gravel terraces and alluvium.

Each type of deposit has a separate designation on the map of superficial deposits (Exh. 11). The vegetated land is divided into two units, dry and marshy ground.

Larger tundra tracts of lans are also illustrated with a special symbol as is "bedrock". The main openings are also shown.

The main constituent of the soil is loess derived from the moraine of the bouldery hillocks. The fine grained part of the moraine is composed of blue-greyish, sandy clay or more precisely of sandi silt. Volcanic ash, mostly from Hekla, also constitutes a major part of the soil materials, the thickest ash and pumice layer being about 40 cm. The soil is very rich in minerals, and becomes more and more sandy towards the Fjórðungssandur plain in the north. There the soil is always shifing showing clear evidence of soil erosion.

Within the area are some tracts of wet bogland with remants of pingos. These pingos are huge mounds "thúfur", 4-20 m in diameter reaching 2 m in height. The mounds retain a perennial ice core and the surrounding bogs also retained ice in the ground during the summer.

The bogs generally have two layers of perennial ice, an upper one about 20 cm below the surface, and less than 10 cm thick, and a lower one at 1 m depth reaching as much as 80 cm in thickness. The upper one probably dates from the previous winter, doubtless frequently disappearing in summer, while the lower layer constitutes the perafrost.

Exposed moraine is the second most common surface type after vegetated land. On surface it is strewn with boulders, but where seen in profile it is rich in clay and silt with single erratic blocks and boulders. A part of the moraine is slightly layered; this layering occurs especially near the bottom where the moraine is most finegrained and may have been deposited as bottom moraine. The topmost meter has been affected by weathering, frost expansion, frost lifting and precipitation. It is to be expected that at 10-20 m depth in the drumlins the moraine has become compact to the extent that coring is possible, i.e. forming tillite, which therefore constitutes the core of most of the morainic hillocks.

Within the project area rather large depressions filled with fine and medium coarse sand, probably wind blown, are also common. The sand is layered and of very uniform grainsize having thinner layers of fine pebbles in between. The sand layers can reach many meters in thickness, but in the depressions the ground water level frequently lies just below or above the sand surface. It is not improbable that the water gives the sand in the depressions cohesion.

Alluvium is mainly to be found along Thjorsá above the tributary Kisa and to a lesser degree elsewhere. The alluvium is layered, consisting of coarse sand and fine gravel.

There occur in the area three eskers, at Miklilækur, Dalsá and below the confluence of Gljúfurá and Thjórsá. The esker at Miklilækur is flat and broad at 555 m elevation. It was formed by the transport of sediment from Miklilækur into an ice-dammed lake behind a frontal moraine ridge. The lake was subsequently emptied as the glacier retreated.

At Dalsá is a somewhat similar but smaller esker at 595 m elevation. There has existed here a shallow icedammed lake as at Miklilækur. As the glacier retreated from the area the lake remained for some time behind a moraine ridge, which Dalsá has since cut its way through.

Below the mouth of Gljúfurá there are to be found eskers more than 30 m high which can be traced downstream along Thjórsá.

The material of the eskers is layered medium coarse and coarse sand with smaller layers of fine pebbles in between.

Chapter 5

Tectonics

Tectonic lineations are demonstrated on the geologic map (Exh. 4) and by fracture rose diagrams (Exh. 12). Table 1 shows the proportional number and direction of fractures in the area. Studies of tectonic lineations were initially done with the aid of aerial photos, but later by field inspection. The effect of the tectonics on the geomorphology is considerable ; the "Thjórsá valley" follows the main fracture direction quite closely. The dominant features of the landscape indicate that the tectonic lineations and volcanic fissures in the area represent the "classic" SW-NE fissure direction of the country. In the uppermost part of the area at Norðlingaalda the effect of other fissure systems is also discernible.

For an easier interpretation of the tectonic fractures they have been listed graphically using rose diagrams. There are three rose diagrams, diagram A representing the area below Dalsá, diagram B the area between Dalsá and the damsite at Norðlingaalda and C the Gljúfurleit area.

In the lowest area, below Dalsá fractures striking N 50 - 65°E are noticeably dominant with N 25 - 45°E as a less conspicuous system. Outside these two sets there is no strongly developed fracture system. In this area the effect of the tectonic lines on the landscape is more prominent than elsewhere. All the larger gulleys as well as the course of Thjórsá are shaped by them although the general pattern of the valley is shaped by glaciers. One fault was observed most clearly seen at Geldingaá, which has a 6.5 m displacement with the downthrow to the west. The fault is parted at Hölkná. It is impossible to predict as to what distance the displacement is active, as at the end of the fracture no displacement is discernible.

In the area between Dalsá and Norðlingaalda the direction of the fractures is considerably more diverse. N 35-45°E striking fractures are most conspicuous being rather uncommon below Dalsá. The N 60°E set is here still rather prominent, while other sets are markedly less prominent. The N 270-280°E set is just beginning to appear. The landscape sculpturing effects of the tectonic lines are here rather less marked than below Dalsá. In the Dalsá channel the effect of the fractures are most evident as the stream frequently flows along narrow fissures.

The fractures in the general area ccan be subdivided into sets. Fissures striking N 30-45°E are dominant coinciding with a part of the prevailing direction of the central volcanic zone of the country, the SW-NE trend. The fracture sets N 50-65°E and N 75°E are also very prominent, this last trend is also well known in Northern and Southern Iceland, e.g. in the Hreppar series. Fractures striking N 10-15°E are best known in Northern Iceland, but occur as a minor trend in most parts of the country. The fracture orientation N 270-280°E is very prominent at Norðlingaalda, but WNW trending fractures become more prevalent to the north. This trend corresponds to the westernmost part of the Snæfellsnes fracture system.

Only one dyke was discovered in the project area, i.e. at Hölkná. The dyke is about 0.4 m wide striking N 60°E.

Chapter 6

Inclination of Strata

The inclination or dip of the strata in the project area is of two kinds. Tectonic inclination due to crustal movements and local inclination due to unconformities and volcanic centres.

Measurements of inclination of the strata are rather limited as openings in general are restricted to one direction (SW-NE). Yet measurements of some planes have been accomplished with the aid of sections in Búðarháls showing the inclination in Gljúfurleit to be 0.2 - 1.0°E-ESE, while the inclination in topmost Matuyama and younger rocks is negligible,being decided by the underlying landscape.

The inclination in the Hreppar series is away from the flexure axis to underneath the volcanic zone.

It occurs as a result of superimposition of younger rock formations produced in the volcanic zone upsetting the previous niveau balance of the crust.

Local dip due to hiatus is rather common in Gljúfurleit. The most obvious case being the correlation of GS-9 and profile E. The normal magnetized rocks at the base of Geldingaá should be at 190 m depth in the borehole, but are in fact completely absent there.

Difference in thickness of sediments often is a clear indication of hiatus. Thus a 50 m thick pile of sedimentary rock in Geldingaá becomes a 7 m thick layer in GS-9.

Inclination resulting from volcanic centres is primarily the dip of the móberg formations and adjoining strata. Dip occurring in this way can amount to as much as 10°.

Chapter 7

Groundwater

Within the project area the groundwater level is everywhere at shallow depth. The spring areas are illustrated on the geological map, Exh. 4. Most of the springs are rather small, but a few are fairly voluminous issuing out under considerable pressure.

The largest spring area is along the upper part of Miklilækur; here the springs are issuing from fractures most of which strike between N 55° - 80°E. These springs are quite numerous and distributed over a farily large area. All of them are rather small coming out under only slight pressure.

In Gljúfurleit there are some springs issuing out under pressure. When tested in borehole GS-10 this pressure proved to be about 0.7 kg/cm^2 at the top of hole.

The springs in these two areas come through fractures in finegrained sandstone appearing on the surface at the contact between the sedimentary rock and the basalt overlying it.

On the damsite at Dalsá there is one spring in the east bank at the contact zone between the moraine and the basalt underneath. This may in fact be surface water percolating down through the moraine and reappearing at the contact. It is also possible, but unlikely, that this is an actual spring in direct contact with the ground water body.

The elevation of the groundwater level in GS-9 has been measured occasionally since drilling of the hole. During this interval it has remained practically stable at about 4,5 m depth in 505 m elevation.

The observed conditions are probably indicative of the general groundwater pattern in the area. The free ground water table should accordingly lie close to the surface and even above it in some places. The boreholes were tested regularly for permeability the result of which showed the rock to be on the whole quite impervious. The permeability of the various rock units in L.U. *) values is

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*) L.U. (Lugeon Units)

as follows : Basalt layers 0-28 L.U. ; Cube jointed basalt and breccia ~ 2 L.U. ; Conglomerate and sandstone 0-10 L.U. ; Contacts 0-60 L.U. ; Fractures < 120 L.U.

As revealed by the tests the permeability of sound and unbroken rock is negligible, but increases greatly with the presence of fractures and contacts. The contact zone as a whole is highly permeable while the interbeds, most often consisting of tight sandstone, are the tightest part of a unit.

The permeability of the upper scoriaceous part of the underlying rock is usually very small as its pores are filled with sediments making it tight. The permeability of this section is decided by the grain size of the smallest particles borne into it, which generally is silt and clay. The lower scoriaceous section of the overlying rock is considerably more open and carries almost all the leakage through the contact zone.

These constitute the horizontal leakage paths, which are decisive for the general leakage pattern as vertical seepage is of little importance. The main vertical seepage paths are fractures and joint planes. Although largely filled with silt and clay fillings these paths seem in some places to be fairly permeable.

Leakage paths at dams and on the canal route can be expected to become tight fairly quickly. The tightening will take place by the silting effect of the fine material of the sediment transport of the river which is mainly silt. The silting up will probably be most active in the breccia.

In autumn 1970 the temperature gradient in the GS-boreholes was measured. In neither of the holes could any appreciable increase in temperature with depth be observed. In borehole GS-10 the temperature was 4.0°C at hole top, but 4.2°C in bottom. The results indicate great downflow in the hole. The inflow probably takes place high up in the hole and by comparison with the temperature in GS-9 the temperature seems to accompany the yearly fluctuation in the temperature of the surface water. According to permeability tests there seems to be inflow into the hole at 50-60 m depth. The temperature measurement indicates that the inflow takes place higher up or else that water has very easy access down to this depth.

In borehole GS-9 the temperature is considerably lower but the gradient steeper. At 10 m depth temperature was 2.4°C, but at bottom 2.7°C. In this hole down-flow is also great, yet the hole is perhaps fairly tight below 200 m. Low temperature indicates that the inflow takes place at greater depth than in GS-10 where it resembles the yearly mean temperature of the surface water. The flow of water both in and out of the hole almost certainly occurs via fractures in the rock in the hole walls.

Chapter 8

Engineering Geology

Exh. 8 and 9 illustrate the classification of the cores from boreholes GS-9 and 10. These holes are located on the proposed power house sites in Gljúfurleit. Exh. 14 shows the correlation between GS-9 and a profile just south of Geldingaá and Exh. 13 is a geological map of the surrounding area.

There are three types of rock, basalt lava layers, móberg and sedimentary rocks. The basaltic lavas have been subdivided into two units, i.e. "basalt" and "porphiritic grey basalt". The two types of rock have the same mechanical properties, but the distinction is made to render the correlation between profiles more easy.

The thickness of individual layers is highly variable ranging from 5 m to 30-40 m. The rock is fairly dense, usually columnar jointed, but the jointing can be highly irregular forming radial jointing or even cube jointing.

Roughly, eack basalt layer can be divided into two sections, i.e. scoriaceous upper and lower zones and a dense inner core. The scoria zones are most often 1-2 m thick. The upper one is usually rich in eolian materials, mainly soil and fine grained sand, which fills the cavities and tightens the rock. The lower scoria zone is generally considerably more open as less quantity of foreign materials have been borne into it.

In Gljúfurleit most fractures, joint planes and cavities in all the rock types are packed with silt and clay and also precipitations, primarily zeolites.

The clay-filled fractures are frequently fairly conspicuous in the core. Generally they are nearly horizontal, but can be inclined as much as 60° in some cases. As a rule they are narrow, but can reach to as much as 4-5 mm width.

The fillings are composed of yellow-brownish glacial clay and silt, mainly basalt glass, almost totally unaltered. Dark green clay was observed on only a single occasion (GS-10, 190 m), which by X-Ray analysis proved to be partly montmorillonite. The danger of swelling in the fractures is therefore minimal.

Some uniaxial compression tests have been performed on cores from the above boreholes. As for basalt the main results are that compressive strength of whole basalt samples varies between 1870-2260 kg/cm^2 for dense basalt and about 500 kg/cm^2 for vesicular basalt. Young's modulus for basalt varies within the limits $1.6 \cdot 10^5$ kg/cm^2 and $7.9 \cdot 10^5$ kg/cm^2.

All the rock samples were dry and selected from the most whole-looking part of each rock layer. The samples contained no fractures or other obvious spots of weakness.

Approximately half of the rock column in Gljúfurleit consists of sediments. These are very varied in structure, varying from coarse tillite to fine-layered silt- and claystone. It is common to find many types of sedimentary rock in one layer, which is most coarse at the bottom and has a gradation to finer grain sizes upwards.

The sedimentary rock is layered except the tillite, yet the contacts do not constitute any serious spots of weakness in the rock; on the contrary the sediments can be considered as a fairly homogeneous mass. The main exceptions are the silt and clay beds which occur in medium coarse sandstone and contacts, where there is great difference in grain sizes.

Uniaxial measurements of sedimentary rock samples showed the compressive strength to be 400-500 kg/cm^2 and that of sandstone about 500 kg/cm^2. One test was performed on medium coarse conglomerate, which gave 192 kg/cm^2. This measurement is hardly comparable with the others as breaks inevitably occur around the larger pebbles. The actual compressive strength of medium coarse conglomerate is therefore like to be as much as twich as high.

Measurements of counglomerate, which had been lying in water and had reached 7-8% moisture content revealed considerably lower strength values or 300-310 kg/cm^2.

Young's modulus for the conglomerate proved to be $1.1 - 1.5 \cdot 10^5$ kg/cm^2, but for the sandstone $2 - 2.5 \cdot 10^5$ kg/cm^2.

The third type of rock is móberg. In Gljúfurleit it occurs mainly as pillow breccia and cube jointed basalt. These two types occur as a rule concurrently and no definite boundary can be drawn between them.

This rock is considerably weaker than the common basalt lavas. The cohesion of the breccia and the coarseness of the cube jointed basalt are such that no problems should be encountered in tunnel driving in them.

The dip of the strata is on the whole rather regular. In the lowest part of the pile of strata where the power house and the tailrace tunnel will be constructed the dip amounts to as much as 1°E - ESE, but decreases upwards to become about 0.2° at the top. Some irregularity can be expected due to hiatus, mainly at the bottom.

There appear two sets of directions, i.e. N20 - 45°E and N60 - 75°E. The latter set is considerably more common and more frequent. Deviations from these hardly exist. The tailrace tunnel route is traversed by one fault striking N65° E.

From the above figures for the geotechnical properties of the rock it seems possible to locate the underground power house in this area. Yet it has to be avoided to create maximum stress in the rock at contacts and where it is weakest. Furthermore account must be taken of the stress conditions in the rock. The most prominent direction of fractures indicates that the major axis of the strain ellipse is at an angle of 45° from the fracture direction.

The Canal Route, Norðlingaalda - Gljúfurleit

Exh. 15 presents a longitudinal section of the canal route, but the location of the section is shown on Exh. 3. The section is drawn from NEA maps at scale 1 : 20.000. Due to certain inaccuracy on these maps the landscape is in many cases slightly to high. This incorrectness appears on the section as a too thick overburden while the bedrock elevation is correct.

The longitudinal section shows surface layers and bedrock strata down to 530 m elevation. The thickness of the overburden is decided by means of borro soundings the location of which is shown on Exh. 3. The rock strata are projected along the canal foute from measured profiles.

The canal route site comprises three rock types, basaltic lava layers (basalt and porphyritic grey basalt), breccia and cube-jointed basalt and sedimentary rock.

The breccia at the diversion sturcture is a part of the Thjórsá balsalt. This is tuff- and pillow breccia with veins of cube-jointed basalt and a cover of cube-jointed basalt of various thickness on top, but the cover of cubejointed basalt is widely dissected. This is the poorest rock on the canal site and leakage as much as 100 L.U. in the uppermost 3-5 m of sound rock can be expected, but hardly more than 30 L.U. below that. According to seismic refraction survey the seismic wave velocity in the rock is 1.3 - 1.9 km/sec. indicating that the rock is rippable with heavy bulldozer. The breccia is highly variable in appearance being probably poorly rippable where most whole looking and where interwoven with basaltic veins. The larger basaltic barriers therefore probably will have to be blasted.

AtDalsá there is breccia for about 4 km distance along the route comprising tuff- and pillow breccia, while at the island on the lower damsite there appear fairly extensive intrusions of basalt, radially jointed basalt and cubjointed basalt. Similar intrusions also occur at the lower part of Miklilækur. The seismic wave velocity of the breccia is 2.4 - 2.6 km/sec and that of the cube-jointed basalt 3.1 - 3.7 km/sec. The boundary between these two rock facies is not distinct, rather they are interwoven into each other. Yet the seismic velocity indicates some kind of boundary about 550-600 m SW of the river. This rock cannot be excavated except by blasting.

The most common type of rock on the canal route is basalt. The basalt is a very dense rock where blasting is everywhere necessary for excavation.

In areas of dense basalt there is no danger of leakage, yet where the contact of two basalt layers meets at the surface the danger of some leakage always persists. Significent leakage is unlikely except at certain contacts where there is thick scoria.

The basalt north of Miklilækur is highly eroded, in some places almost through to the underlying strata. This is expecially conspicuous at Miklilækur where only patches of basalt remain. This basalt probably does occur as a more uniform layer, but nowhere does it reach great thickness, it extends to above Kisa, but there ajoins the Thjorsá basalt.

The basalt next to Geldingaá is considerably broken next to the surface. Similarily rock exposed at the surface is weathered mainly due to frost, which is capable of forming fairly wide open fractures down to 1-2 m depth. These fractures constitute major paths of leakage making it necessary to scrape all weathered rock from the surface and seal the deeper fractures.

Where the bedrock is concealed by 1-2 m of superficial deposits weathering to any appreciable degree is not to be expected. The lowest part of the surface layer often abounds with boulder drift mixed with sand and silty earth. This can be explained as morainic debris and at least at one locality dense moraine was observed below the overburden just south of Hölkná, where the boulder drift is most conspicuous.

The third type of rock is sedimentary rock, mainly conglomerate and sandstone. The sediments as a whole form dense rock and canal excavation in it should not pose any problems.

Damsite in Thjorsá at Hvanngiljafoss (Section P-P, Exh. 17)

At Hvanngiljafoss there are great accumulations of sediments, the Hvanngil sedimentary rocks (H.S.). On the damsite are found two types of sediments, i.e. sandstone and coarse conglomerate. In the river channel the rock consists of very tuffaceous sandstone intermingled with small pebble and conglomerate layers. The rock is dense and has all the characteristics of coarse sandstone except for being rather soft.

At 5-7 m beneath the river bottom there is coarse conglomerate. Between the different sedimentary types are clearly defined contacts and they seem to weather down most easily. The conglomerate becomes coarser with depth and resembles coarse badly consolidated tillite at the bottom. The rock as a whole is badly consolidated and there is considerable risk of leakage.

The lower limit of the H.S. is difficult to determine. Here the contact is expected to lie at 490 m elevation but due to unconfirmities it can as well be 5 m lower.

The H.S. is underlain by dense almost non-porphphitic basalt, which is eroded and without scoria on the surface making the contact sharp and probably rather permeable. The basalt barely exceeds 10 m thickness.

The power tunnel is supposed to be at 483-489 m elevation. If the contact is correctly located it will traverse the upper part of the tunnel, where it poses great danger of leakage and the badly consolidated conglomerate will form the roof or be situated just above it.

Underneath the SW part of the Kjálkaversalda is breccia, tuffaceous and well consolidated and dense. It appears on the surface at the spillway site.
The breccia is overlain by cube-jointed basalt, which underlies Kjálkaversalda and forms its core.

The basalt is often very roughly jointed forming rochees moutonnees in places. In other places the rock is farily well brecciated. It should form a more sound foundation for a spillway, but to make use of this the spillway has to be located further to the NE.

The Kjálkaversalda area itself is composed of moraine being most likely about 20 m thick where thickest.

The river shannel is shaped by the tectonics. The major fractures strike N 45 - 65°E with a subordinate set of fractures running at right angles to the main set. The fractures are an outstanding feature in the area and regard must be paid to them in the design of structures.

Damsite in Miklilækur between Kjálkaversalda and Digraalda (Section Q-Q, Exh. 18)

The damsite is for the most part founded on Hvanngil sedimentary rocks. In the east bank these are highly varied but above 511 m elevation consist of fairly compact sandstone and fine conglomerate. Below this limit the rock is badly consolidated and resembles in many respects the lowest part of H.S. as it appears at Hvanngiljafoss but is much more irregular. Crossbedding is prominent, inclination amounting to as much as 60°. The more finegrained layers are composed of tuffaceous sandstone and fine conglomerate the most coarse layers being bouldery rock. The most coarse layers are most badly consolidated being hardly any better than poorly cemented moraine. This rock is probably highly permeable the coarse layers constituting the main leakage paths.

At the damsite the rock is most sound, i.e. fairly compact conglomerate with small pebbles. How far this type of rock reaches into the river bank is impossible to predict. A rather small spring issues out of the sediments through a fracture striking N70°E, but no water could be observed passing out elsewhere along the fracture.

The west bank of the stream differs from the east one, consisting entirely of dense claystone conglomerate resembling in many ways fine-grained moraine from the last glacial. This formation should be a good foundation for a dam, but the weathered material on the bank edge will have to be scraped away.

At the damsite the river bottom is of finegrained conglomerate. Somewhat below the actual damsite breccia is visible in the sediment in a few places. Breccia could possibly be at shallow depth below the river bottom but this is uncertain.

Digraalda consists of móberg, mainly tuff breccia but also pillow breccia. The rock is well consolidated and good foundation for a dam.

Damsite in Thjórsá at Krókur (Section R-R, Exh. 19)

The topography of the damsite is marked by an unconformity, the inclination of the strata being decided by the surface features of the underlying sedimentary rocks ; as a result the porphiritic grey basalt dips towards the river on both sides of it. The dam will be founded on sound rock consisting for the most part of very dense grey basalt being fine and radially jointed in restricted sections. The sediments, consisting of conglomerate in the upper half and sandstone lower down, probably lie at shallow depth beneath the river bottom.

Where founded on rough jointed rock there is no danger of leakage through the contact zone, but where radially jointed the danger of leakage increases as the contact may be not far away.

On the surface there are even striated rock outcrops only slightly worn by the weathering; it should therefore be possible to build the dam direct on the rock without scraping off of the surface. Some tightening of the major fractures may become necessary.

Damsite in Miklilækur (Section S-S, Exh. 20)

The bedrock consists to a great extent of sediments, here termed Hvanngil sedimentary rocks, solely because of comparable nature and qualities. In the southern bank the sediment consists of dense, rather fine-grained conglomerate with smaller layers of coarse sandstone in between. The sediment is underlain by porphyritic grey basalt which extends down into the river channel, but which cannot be found at the other bank. Underneath the basalt is another sedimentary layer, apperently the same as on the NE bank. The whole of the sediment looks similar.

In the NE bank of the stream an extensive basalt layer can be seen reaching to above Kisa. According to borrosoundings and test pits on the damsite this layer is often highly eroded and in some places completely dissected by erosion. This layer should therefore not be expected to outcrop close to the river bank, but discontinuous basalt outcrops and a drift of boulders can be expected on top of the sediment for the first 200-250 m and then a thin, broken lava layer.

The dense rock is fairly impervious, but rather large open fractures should be expected in the basalt, capable of carrying great leakage. During the dam construction special attention should be paid to broken basalt as it inevitably has to be removed to a certain extent.

Upper Damsite in Dalsá (Section T-T, Exh. 21)

The greater part of the damsite consists of moraine. A moraine ridge (drumlin) traverses the damsite parallel to the dam axis. The moraine is a mixture of different grain sizes and because of the finer groups, silt and clay, it is a fairly dense and sound dam foundation. Usually the moraine can be divided into three layers according to its strength. The topmost 1-2 m constitute the weathered top layer, then there is 15-20 m of moraine, constantly getting harder with depth grading into tillite.

Beneath the moraine is a basaltic layer, appearing in the river banks. This rock will form the spillway and is very suitable for that purpose. At the contact between these two rock types a spring is distinctly seen at one location with water emerging at other localities on a smaller scale. This is probably surface water, which has percolated through the weathered part of the moraine and reappears at its contact with the basalt.

The contact zone between the moraine and basalt is the main parth for horizontal leakage. At Dalsá this is rather open and probably needs grouting or other comparable means of tightening.

Damsite in Dalsá (Section U-U, Exh. 22)

The entire damsite rests on móberg, mainly tuff and pillow breccia. At a single locality in Dalsá cube-jointed basalt and radially jointed basalt are to be found. The whole of the lower part of the island and the damsite consists of this rock, but the upper part of pillow breccia. The lower part of the móberg is at approximately 525 m elevation, while below there is probably porphyritic grey basalt or sediments.

The breccia and cube-jointed basalt have enough foundation strength for large structures. The breccia is generally fairly dense and is evenly distributed in all directions. Leakage in the cube-jointed basalt is considerable being governed by joint planes.

On the damsite the course of the river is governed by fractures as it flows along large fractures on either site of the island. These fractures constitute the main paths of leakage.

Those fractures running perpendicular to the direction of the dam can cause great leakage making it necessary to tighten the rock for a considerable depth.

Damsite in Kisa (Section V-V, Exh. 23)

Due to excessive erosion of the bedrock and the great thickness of soil cover the nature of the dam foundation is difficult to assess. The Hvanngil sediment has previously been overlain by a lava layer, which was subsequently reduced in extent down and in some cases completely eroded away. Near the river on the NE bank and probably also underlying the whole of the damsite H.S. constitutes the bedrock. Farther to the east, i.e. higher up in the bank, the lava may be expected to underlie the dam. In the west bank there are probably lava patches farthest to the west, but which would soon disappear. Dam construction would necesstate the scraping off of this rock.

Here as elsewhere the H.S. would probably make a good, dense foundation for a dam. All leakage would be through fractures. It might become necessary to put up a grouting curtain below the river bottom and also possibly on the NE bank.

Upper Damsite in Kisa (Section X-X, Exh. 24)

The river here flows along a 20 m deep gulley which is cut into breccia, belonging to the Norðlingaalda móberg and consisting to a large extent of pillow breccia. In the damsite area the breccia is fairly rich in basaltic injections and outliers of cube-jointed basalt.

The breccia probably also underlies the proposed spillway, the site of which is covered by loose moraine. The moraine in the hills on either side of the spillway appears to be more sound. The thickness of the moraine on the damsite is difficult to assert, but the estimated maximum thickness is about 7-8 m.

East of Kisa on top of the breccia there is an esker striking southeast which can be easily followed for about 1 km. It is primarily composed of sand and gravel. Dam construction would necessitate the scraping off of the esker material which may be underlain by a thin moraine layer. Leakage in thebreccia is fairly high, but less than in the Þjórsá basalt.

Damsite at diversion (Section Y-Y, Exh. 25)

The dam would be built on basalt for the most part but also on sedimentary rock. The basalt is everywhere considerably broken on the surface and frost cracks can be seen reaching down to at least 1 m depth. All the weathered rock has to be cleared from below the dam and tightened where most open. Below the weathered surface the rock is sound and good as a dam foundation.

The sedimentary rock is mostly black, tuffaceous sandstone with small pebbles and bands of small pebbles in between. Farther down the rock seems to become more coarse grading into conglomerate.

The contact zone between the basalt and sedimentary rock below is fairly impervious as far as is observable. The scoria layer is rather thin and seems to be clayfilled in many cases. In spite of this some leakage can be expected through the contact, where it is exposed to the surface.

TABLE 1
TAFLA

Staðsetning og dýpi borhola

Location and depth of drillholes

Hola Nr. / Hole No.	Hnit / Co-ordinates Y	X	Toppur fóðurrörs m y.s. / Top of casing, el.	Dýpi / Depth m	Botn holu m y.s. / Bottom of hole, el.
GS 2	439.974,87	547.329,69	555,8	17,0	538,8
GS 9	425.642,11	561.928,63	509,4	240,5	268,9
GS 10	423.278,50	563.978,00	489,7	225,0	264,7

TABLE 2
TAFLA

Direction of fractures, also presented on Rose Diagrams, Exh. 12.

Sprungustefnur, einnig sýndar á sprunguósum, Mynd 12.

a)

Sprungustefnur	Gljúfurá-Dalsá %	Dalsá-Norðlingaalda %	Allt Svæðið %
270°		2.8	1.4
275°			
280°		0.9	0.5
285°		1.0	0.5
360°	0.9		0.5
5°			
10°		2.8	1.4
15°		2.8	1.4
20°			
25°	1.9		1.0
30°	18.5	1.0	9.7
35°	6.5	23.0	14.8
40°	7.4	28.5	18.0
45°	6.5	8.6	7.5
50°	9.2	1.9	5.5
55°	14.8		7.4
60°	16.7	3.8	10.2
65°	13.0	4.8	8.9
70°	2.8	1.0	1.9
75°	1.8	13.3	7.6
80°			
85°		3.8	1.9

TABLE 2 CONT:
TAFLA

b)

Direction of fractures in the Gljúfurleit area
Sprungustefnur í Gljúfurleit.

20°	11,6%
25°	7,2-
35°	3,5-
40°	15,7-
45°	1,7-
60°	22,1-
65°	30,2-
70°	2,4-
75°	5,6-

TABLE 3
TAFLA

LINE GSB 01
SKURÐLÍNA GSB 01

Location and depth of borro-soundings
Staðsetning og dýpi borro-hola

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning Y	X	Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning Y	X
001	0.6	547.8	440.113.94	546.291.38	51	1.1	543.7		
2	1.2	547.8			52	2.3	543.6		
3	1.2	548.5			53	6.0	548.4		
4	0.9	548.3			54	3.6	548.7		
5	1.0	548.3			55	5.5	550.3		
6	0.9	549.2			56	5.2	551.8		
7	0.6	550.3			57	5.4	552.9		
8	2.4	550.2	439.898.8	546.958.3	58	4.6	553.6		
9	1.5	549.9	439.895.3	547.055.5	59	3.6	553.3		
10	0.7	551.1			60	2.5	552.2		
11	0.7	553.5			61	1.3	549.2		
12	1.1	554.7			62	5.2	553.5		
13	1.1	555.7			63	4.3	552.6		
14	0.7	555.7			64	4.8	552.4		
15	0.6	553.8			65	5.4	552.8		
16	2.0	549.4	439.970.6	547.751.5	66	4.9	552.8		
17	4.2	549.2	439.947.4	547.846.4	67	3.4	553.3		
18	3.3	548.7			68	2.1	553.4		
19	2.2	548.3	439.869.1	548.030.4	69	4.1	553.3		
20	4.3	548.1			70	1.7	552.2		
21		548.0			71	0.9	553.0		
22		548.1			72	0.9	551.4		
23		548.0			73	1.1	551.3		
24		548.2			74	2.8	550.8		
25	1.4	548.3			75	0.8	551.6		
26	2.6	548.8			76	0.0	548.8		
27		549.4			77	1.6	548.5		
28		550.2			78	1.3	550.2		
29	2.4	550.2			79	0.7	552.2		
30	2.0	549.3			80	0.5	550.9		
31	1.0	549.3			81	1.0	550.1		
32	1.2	549.1			82	1.1	549.4		
33	2.7	548.3			83	1.9	548.7		
34	2.0	548.0			84	1.1	549.1		
35	1.5	547.9			85	1.3	547.7		
36	2.2	548.2			86	1.3	547.5		
37	1.7	547.5			87	0.6	548.1		
38		546.9			88	0.9	548.5		
39		546.8			89	0.0	548.3		
40		546.5			90	0.0	549.5		
41		546.2			91	0.5	550.5		
42		545.9			92	1.1	550.9		
43		545.0			93	0.7	549.9		
44		545.3			94	0.0	548.5		
45		544.9			95	0.0	547.3		
46		545.2			96	0.0	547.7		
47		542.9			97	0.9	546.6		
48	2.0	544.6			98	4.5	547.7		
49	1.0	544.2			99	2.2	546.5		
50	1.0	544.0			100	4.2	543.5		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning		Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m	Coordinates Staðsetning	
			Y	X				Y	X
101	5.7	541.1			151	3.0	543.7	431.612.3	557.094.6
102	6.8	539.5			152	2.5	549.2	431.525.3	557.144.1
103		535.1			153	2.4	546,0	431.438.3	557.193,6
104	1.3	532.9			154	1.2	546.3	431.351.4	557.243.2
105	0.5	540.4			155	3.6	546.6	431.264.4	557.292.7
106	0.5	542.6			156	3.5	544.7	431.177.4	557.342.2
107	1.8	544.2			157	2.3	544.0	431.090.4	557.391.7
108	3.2	546.8			158			431.003.4	557.441.2
109	3.0	546.8			159			430.916.4	557.490.8
110	1.9	552.4			160	0.0		430.829.4	557.540.3
111	1.5	555.5			161	2.1	546.4	430.742.4	557.589.8
112	2.5	553.3			162	1.3	548.5		
113	2.5	552.9			163	1.2	544.9		
114	5.1	553.0			164	3.0	547.0		
115	8.6	551.5			165	4.4	548.9		
116	6.6	548.6			166	1.0	549.6		
117	4.0	548.0			167	0.6	551.1		
118	3.3	541.1			168	0.8	551.3		
119	5.5	545.0			169	1.3	551.6		
120	2.8	544.9			170	1.4	551.4		
121	6.1	547.9			171	1.0	552.0		
122	0.3	546.5			172	0.6	550.2		
123	3.0	545.5			173	1.0	550.1		
124	0.7	551.0			174	1.2	550.4		
125	2.2	550.1			175	2.0	550.3		
126	2.3	549.0			176	2.0	550.9		
127	6.5	548.2			177	3.2	552.3		
128	3.5	548.8			178	2.5	552.6		
129	2.5	549.4			179	2.5	553.4		
130	3.5	549.5			180	3.5	553.5		
131	3.9	549.5			181	3.7	553.9		
132	2.1	548.5	433.265.13	556.153.71	182	2.5	554.0		
133	1.9	550.0	433.178.1	556.203.2	183	1.5	553.6		
134	0.8	546.8	433.091.1	556.252.8	184		552.0		
135	1.9	549.0	433.004.2	556.302.3	185	2.5	547.7		
136	0.2	547.6	432.917.2	556.351.8	186	2.0	546.9		
137	1.0	547.9	432.830.2	556.401.3	187	2.5	545.0		
138	2.5	548.6	432.741.2	556.450.8	188	1.0	540.6		
139	2.2	550.1	432.656.2	556.500.4	189	3.6	546.5		
140	2.5	550.6	432.569.2	556.549.9	190	2.3	548.5		
141	2.4	548.4	432.482.2	556.599.4	191	4.0	548.1		
142	0.3	545.6	432.395,2	556.648.9	192	3.4	546.7		
143	0.6	544.8	432.308.2	556.698.5	193	2.5	544.7		
144	1.5	548.3	432.221.3	556.748.0	194	3.0	545.5		
145	2.5	546.8	432.134,3	556.797.5	195	2.9	545.3		
146	2.8	546.2	432.047.3	556.847.0	196	3.3	546.4		
147	3.6	546.0	431.960.3	556.896.5	197	4.5	547.7		
148	4.0	546.8	431.873.3	556.946.0	198	4.1	548.9		
149	2.6	544.8	431.786.3	556.995.6	199	3.3	549.3		
150	2.8	543.6	431.699.3	557.045.1	200	4.8	549.0		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning Y	X
201	4.2	546.0		
202	4.9	546.4		
203	4.1	547.0		
204	2.5	546.8		
205	0.6	538.0		
206	1.2	545.3		
207	2.4	543.8		
208	1.8	543.7		
209	1.1	543.1		
210	1.0	543.0		
211	2.3	544.4		
212	2.7	541.8		
213	2.4	543.0		
214	2.7	544.9		
215	1.0	544.4		
216	1.5	543.0		
217	1.0	544.1		
218	2.0	545.4		
219	3.1	546.5		
220		544.7		
221	0.4	546.0		
222	1.1	544.6		
223	1.1	545.2		
224	1.2	546.2		
225	3.0	547.8		
226	3.1	548.3		
227	3.0	548.4		
228	3.6	549.1		
229	2.8	549.5		
230	4.5	547.4		
231	3.3	549.2		
232	0.6	548.3		
233	4.0	550.6		
234	0.0	551.5		
235		553.8		
236	1.4	(555.63)		
237	5.4	551.00)		
238		551.32		
239	1.1	(544.80)		
240	3.0	548.18		
241	3.4	544.3		
242	1.6	548.6		
243	1.2	546.3		
244	1.9	548.8		
245		547.4		
246	2.9	548.0		
247	3.2	549.7		
248	2.1	544.9		
249	1.8	546.6		
250	1.7	547.3		
251	2.9	546.9		
252		549.0		
253	1.3	551.2		
254	1.9	548.0		
255	1.6	545.6		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m	Coordinates Staðsetning Y	X
256	2.4	546.8		
257	1.2	546.2		
258	2.5	547.8		
259	3.1	548;9		
260	3.2	549.00		
261	2.7	550.8		
262	1.2	550.9		
263	x	548.8		
264	3.7	553.8		

LINE GSB 02

SKURÐLÍNA GSB 02

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m	Coordinates Staðsetning Y	X
001	0.05	545.0		
002	0.2	546.5		
003	0.4	547.1		
004	0.6	547.0		
005	1.4	546.0		
006	1.0	546.0		
007	0.9	545.9		
008	2.8	548.2		
009	5.0	549.2		
010	4.1	548.1		
011	1.4	548.3		
012	0.8	553.7		
013	0.7	555.6		
014	0.9	555.7		
015	0.7	555.3		
016	1.1	549.6		
017	1.4	551.2		
018	1.0	549.7		
019	1.9	550.3		
020	2.4	550.0		
021	4.3	550.5		
022	4.5	550.5		
023	2.5	550.1		
024	3.9	549.2		
025	3.4	548.9		
026	3.2	549.2		
027	3.9	549.10		
028	3.4	549.6		
029	2.8	549.6		
030	2.1	548.9		
031	2.5	548.8		
032	1.8	548.6		
033	1.9	548.3		
034	2.1	549.0		
035	0.8	549.8		
036	1.1	550.0		
037	3.0	547.3		
038	1.5	547.1		
039	2.0	549.6		
040	0.6	548.1		
041		546.3		
042		546.1		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning Y	X
043	5.0	548.5		
044		549.9		
045	2.9	549.5		
046		545.5		
047	2.5	546.0		
048	0.5	546.0		
049	1.3	543.3		
050	1.0	543.9		
051	2.0	543.6		
052	1.0	543.4		
053	2.0	542.9		
054	1.4	542.7		
055	6.0	549.0		
056	4.7	549.9		
057	2.6	551.0		
058	4.6	551.0		
059	5.5	552.7		
060	4.3	551.6		
061		550.1		
062	3.0	550.2		
063	5.3	551.2		
064	6.4	551.2		
065	5.5	551.3		
066	5.4	551.3		
067	4.5	551.7		
068	4.0	551.9		
069	5.1	552.0		
070	3.7	551.4		
071	0.8	550.7		
072	0.9	549.6		
073	1.3	548.5		
074	0.8	548.2		
075	1.2	547.2		
076	0.5	545.6		
077		548.1		
078	0.3			
079	0.7	548.9		
080	0.0	546.7		
081	1.4	548.5		
082	0.0	546.2		
083	3.7	547.9		
084	1.7	547.4		
085	1.6	545.9		
086	0.9	544.7		
087	0.0	546.6		
088	1.6	547.9		
089	1.2	547.1		
090	0.9	549.7		
091	0.8	549.0		
092	1.0	548.8		
093	1.0	548.1		
094	1.7	548.5		
095	2.6	547.3		
096		545.2		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m	Coordinates Staðsetning Y	X
097				
098	3.3	546.7		
099		542.2		
100		537.9		
101		540.9		
102		537.9		
103		534.9		
104	0.7	532.8		
105	0.5	534.6		
106	4.3	542.6		
107	3.0	544.1		
108	2.5	544.5		
109	2.6	546.5		
110	2.5	551.7		
111	2.5	552.5		
112	2.5	552.7		
113	4.5	552.6		
114	3.5	552.7		
115	1.5	555.4		
116	1.5	549.7		
117	3.0	548.8		
118	3.5	544.9		
119	3.6	541.3		
120	2.1	541.9		
121	4.0	543.5		
122	0.5	545.7		
123	1.8	544.1		
124	2.0	548.2		
125	2.3	548.3		
126	3.9	547.0		
127	5.0	547.7		
128	3.7	548.5		
129	6.3	549.0		
130	1.9	549.5		
131	2.9	548.5		
132	1.4	549.2		
133	2.0	548.0		
134	1.3	546.7		
135	0.3	547.5		
136	0.4	545.6		
137	0.9	544.5		
138	1.3			
139		546.2		
140	3.2	547.2		
141	2.0	547.1		
142	1.0	546.7		
143	1.2	541.9		
144	2.5	542.7		
145	2.3	543.6		
146		543.5		
147	5.9	542.1		
148	4.0	541.9		
149	3.3	541.0		
150	1.0	536.9		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning Y	X	Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m	Coordinates Staðsetning Y	X
151	3.8	541.5			203	3.0	545.2		
152	1.5	545.5			204	3.5	542.1		
153	3.0	541.7			205	2.1	538.1		
154	3.5	539.9			206	3.5	539.8		
155	2.5	538.7			207	1.2			
156	3.6	539.4			208	1.8	540.6		
157	2.0	539.2			209	0.6	540.3		
158					210	1.2	539.8		
159					211	0.8	540.2		
160					212	0.5	539.3		
161	1.5	546.4			213	1.3	539.4		
162	0.7	546.7			214	1.1	542.0		
163	2.8	544.7			215	0.7	541.6		
164	4.0	547.0			216	0.6	543.4		
165	3.0	549.5			217	1.6	541.8		
166	2.4	547.6			218	1.5	541.4		
167	0.7	551.1			219	x	543.7		
168	1.4	551.6			220	x	543.3		
169	2.1	551.5			221	0.2	543.6		
170	1.1	551.1			222	1.0	543.4		
171	0.5	551.5			223	0.8	544.6		
172	0.5	549.8			224	1.5	543.9		
173	1.0	550.5			225	0.6	544.5		
174	1.1	549.6			226	1.1	544.5		
175		549.5			227	3.5	546.8		
176	2.1	549.8			228	2.5	546.2		
177	2.6	550.9			229	3.8	545.7		
178	4.0	551.0			230	3.1	545.6		
179	3.3	551.5			231	5.9	543.9		
180	3.5	551.8			232	x	538.1		
181	3.0	551.3			233	3.5	547.8		
182	2.2	551.4			234	x	543.5		
183	1.1	552.1			235	2.5	546.4		
184	0.9	552.1			236	3.4			
185	1.0	554.3			237	6.3	545.2		
186		544.3			238	3.4	541.6		
187	0.8	543.2			239	1.1	540.4		
188	0.8	539.9			240	4.8	544.2		
189	3.8	543.7			241	1.3	543.4		
190	1.9	545.2			242	2.4	545.2		
191	0.9	549.9			243	0.0	541.4		
192	1.1	550.4			244	1.6	539.3		
193	3.0	545.5			245	1.2	(537.9)		
194	2.2	544.1			246	2.6	(543.2)		
195	0.4	540.4			247	1.1	(543.4)		
196	2.4	544.0			248	x	(535.0)		
197	5.2	545.9			249	x	(538.0)		
198	6.2	545.1			250	x	(541.5)		
199	4.8	546.6			251	0.6	(544.3)		
200	4.5	545.4			252	1.0	(541.1)		
201	9.3	544.4			253	1.1	(546.7)		
202	4.5	542.9			254	1.4	(539.8)		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning Y	X
255	1.3	(541.60)		
256	2.2	(539.10)		
257	1.1	(541.40)		
258	3.3	(545.15)		
259	x	(545.00)		
260	x	(545.10)		
261	x	(546.00)		
262	x	(548.40)		
263	1.4	(546.80)		
264	0.4			
265				
266				
267				
268				

LINE GSB 03

SKURÐLÍNA GSB 03

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning Y	X
001	0.7	550.8		
2	0.7	551.5		
3	0.8	550.7		
4	0.7	550.7		
5	1.3	550.9		
6	0.5	553.2		
7	2.4	551.8		
8	2.6	552.6		
9	0.8	551.9		
10	0.6	555.0		
11	0.9	556.5		
12	0.8	556.2		
13	1.2	556.2		
14	0.5	553.4		
15	2.2	552.9		
16	3.1	549.9		
17	9.0	549.5		
18	9.0	549.0		
19		548.1		
20				
21				
22				
23				
24				
25	4.2	548.7		
26	1.4	549.4		
27	2.0	549.5		
28	2.3	550.6		
29	2.6	549.6		
30	0.8	549.7		
31	2.5	549.2		
32	2.1	548.6		
33	5.4	548.5		
34	7.6	548.3		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m	Coordinates Staðsetning Y	X
35	8.6	547.9		
36	5.9	547.8		
37	7.0	547.3		
38		547.1		
39		547.0		
40		546.8		
41		546.4		
42		546.0		
43		545.8		
44		545.5		
45		545.3		
46		544.7		
47	5.4	547.6		
48	4.0	544.7		
49	4.1	544.4		
50	1.5	543.9		
51	6.0	550.2		
52	5.5	551.2		
53	4.1	551.2		
54	3.1	550.1		
55	3.5	551.8		
56	3.5	553.0		
57	1.0	553.5		
58	1.2	552.5		
59	2.1	553.3		
60	1.3	551.3		
61	5.2	553.4		
62	5.0	553.5		
63	4.6	553.3		
64		553.5		
65		553.8		
66	4.4	554.3		
67	3.2	555.0		
68	3.0	553.6		
69	0.1	553.8		
70	1.8	554.3		
71	0.8	556.5		
72	0.6	555.0		
73	1.6	552.7		
74	0.7	552.5		
75	0.0	552.4		
76	0.6	553.8		
77	0.6	552.8		
78	1.1	553.6		
79	1.2	553.8		
80	1.1	552.7		
81	0.6	551.2		
82		550.7		
83	1.2	551.8		
84	1.6	551.7		
85	0.8	549.9		
86		549.0		
87		550.1		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning Y	X	Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m	Coordinates Staðsetning Y	X
88	0.4	549.2			144	0.0	547.7		
89	1.9	550.5			145	3.1	548.5		
90		550.2			146	3.0	549.6		
91		552.4			147		549.6		
92	1.0	551.5			148	3.5	549.5		
93	0.9	550.5			149	2.7	549.3		
94	2.2	548.7			150	2.0	547.0		
95		548.0			151	2.0	549.7		
96		549.7			152	2.0	550.2		
97	4.2	548.5			153	2.0	550.9		
98	5.3	550.1			154	3.1	551.0		
99	2.6	547.3			155	2.5	549.7		
100	5.0	543.2			156	3.2	549.3		
101	0.0	544.0			157	2.1	547.5		
102	4.1	539.3			158				
103	1.4	533.9			159				
104	0.0	536.2			160				
105	3.1	544.3			161	2.1	547.2		
106	3.5	547.0			162	2.5	548.1		
107	1.2	545.7			163	2.0	549.6		
108	0.6	545.9			164	3.0	549.7		
109	0.6	549.6			165	1.7	550.7		
110	0.6	551.9			166	1.0	552.4		
111	1.1	557.9			167	0.5	554.4		
112	3.1	557.3			168	0.5	553.6		
113	2.5	554.1			169	0.8	554.5		
114	3.0	552.6			170	1.0	553.0		
115	0.9	546.7			171	0.5	553.7		
116	4.2	550.2			172	1.5	552.0		
117	5.1	549.7			173	1.0	551.4		
118	3.1	548.7			174	0.5	551.3		
119	5.5	548.8			175	0.6	552.7		
120	6.5	548.6			176	1.5	553.2		
121	5.3	551.5			177	1.5	553.6		
122	1.2	549.8			178	1.4	554.3		
123	2.9	550.1			179	1.0	553.8		
124	1.3	551.8			180	1.2	554.5		
125	2.5	551.9			181	1.3	553.2		
126	2.1	554.4			182	1.4	554.6		
127	5.9	549.3			183	1.5	553.0		
128	2.4	549.3			184	4.8	553.7		
129	3.0	550.2			185	2.6	551.0		
130	2.1	550.9			186	1.1	547.9		
131	1.5	552.0			187	1.2	545.4		
132	0.8	549.3			188	0.6	544.4		
133	0.5	551.0			189	3.2	548.7		
134	0.3	551.5			190	2.5	549.4		
135	2.1	551.0			191	3.5	548.5		
136	0.5	549.9			192	4.2	547.1		
137	0.6	549.3			193	1.4	544.1		
138	0.8	549.0			194	1.9	544.8		
139	0.9	549.6			195	1.2	544.4		
140	0.6	550.9			196	4.1	548.1		
141	0.5	547.6			197	4.0	549.3		
142		549.3			198	4.1	549.9		
143	0.0	550.4			199	3.5	549.9		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m y.s.	Coordinates Staðsetning Y	X
200	2.6	550.2		
201	3.2	548.9		
202	3.1	549.2		
203	5.1	549.3		
204	4.4	548.1		
205	4.4	547.2		
206	1.2			
207	2.0			
208	2.0	549.9		
209	2.3	549.0		
210	3.0	547.3		
211	2.3	547.1		
212	2.5	546.7		
213	1.5	547.7		
214	1.8	547.3		
215	1.1	547.7		
216	2.0	548.6		
217	2.5	548.5		
218	2.3	547.6		
219	x	547.4		
220	3.0	547.5		
221	1.5	545.8		
222	2.3	548.2		
223	3.4	548.5		
224	3.3	548.2		
225	3.0	551.0		
226	2.5	550.7		
227	3.6	551.1		
228	3.5	551.3		
229	6.0	552.1		
230	4.1	553.2		
231	4.0	555.1		
232	0.7	554.4		
233	1.0	555.3		
234	0.4	558.4		
235		(556.90)		
236	1.1	(558.40)		
237	x	(548.00)		
238	0.9	(550.50)		
239	0.0	(548.00)		
240	0.0	(552.90)		
241	0.1	(550.50)		
242	3.1	(552.40)		
243	0.6	(551.90)		
244	2.2	(554.00)		
245		(549.70)		
246	3.1	(552.95)		
247	3.4	(554.00)		
248	2.3	(552.40)		
249	x	(548.50)		
250	x	(552.00)		
251	1.0	(552.70)		

Sounding No Hola Nr.	Depth Dýpi m	Elev. Hæð m	Coordinates Staðsetning Y	X
252		(552.40)		
253	2.9	(552.40)		
254	0.4	(548.90)		
255	2.4	(549.50)		
256	0.1	(548.50)		
257	0.4	(564.00)		
258	2.2	(552.10)		
259	4.4	(554.80)		
260	x	(552.20)		
261	0.7	(553.35)		
262	x	(555.00)		
263	x	(553.00)		
264	x			

LINE GSB 05

SKURÐLÍNA GSB 05

48	3.5	(548.4)		
49	5.1	(549.3)		
50	6.0	(548.2)		
51	6.0	(548.4)		

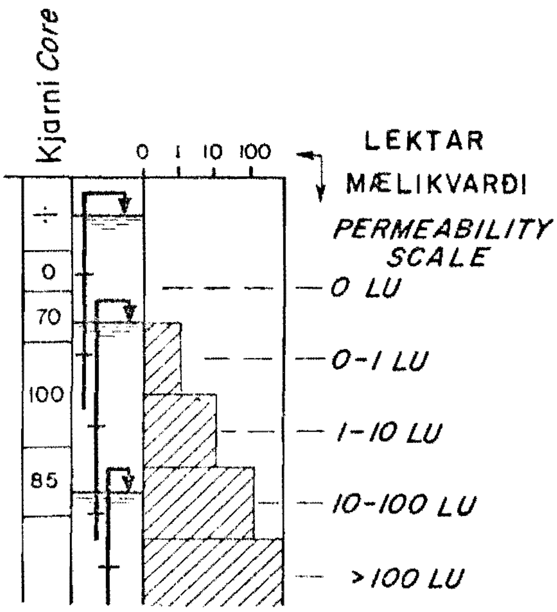
LINES

BORRO-LÍNUR

GSB 11 og GSB 10

GSB 11001	1.1	(559.0)		
002	0.9	(542.8)		
003	2.2	(540.0)		
004	7.2	(543.6)		
005	5.1	(544.3)		
006	4.9	(545.7)		
007	2.1	(547.7)		
008	3.1	(548.2)		
009	5.3	(547.5)		
010	2.7	(549.5)		
011	2.7	(552.1)		
10001	1.4	(551.5)		
002	2.2	(549.7)		
003	4.3	(545.0)		
004	3.6	(545.5)		
005	1.7	(548.5)		
006	0.8	(556.0)		

MYND *Exh.* 0.00	ORKUSTOFNUN Raforkudeild KJARNA-, LEKTAR OG JARÐVATNSÚTSKÝRING *NOTE ON CORE PERMEABILITY AND GROUND WATER*	18/9'70 HT/EK Tnr. 204 B – Ým. Fnr. 9586



LEKTAR-OG JARÐVATNSÚTSKÝRING

NOTE ON PERMEABILITY AND GROUND WATER

Jarðvatnsborð er sýnt með örvum. Neðri endi örvarinnar og þverstrikin sýna holudýpið, þegar jarðvatnsborðið var mælt. Ef jarðvatn breytist ekkert í borun, nær örin í botn.

Ground water levels are shown by arrows. Base of the arrows and the horizontal bars indicate the hole depth when the water level was measured. If no change in level was observed during drilling, the arrow reaches the bottom of the hole.

1 LU = Lugeon Unit = 1 l/mín/m í 76 mm Ø holu við þrýsting 10 kg/cm^2

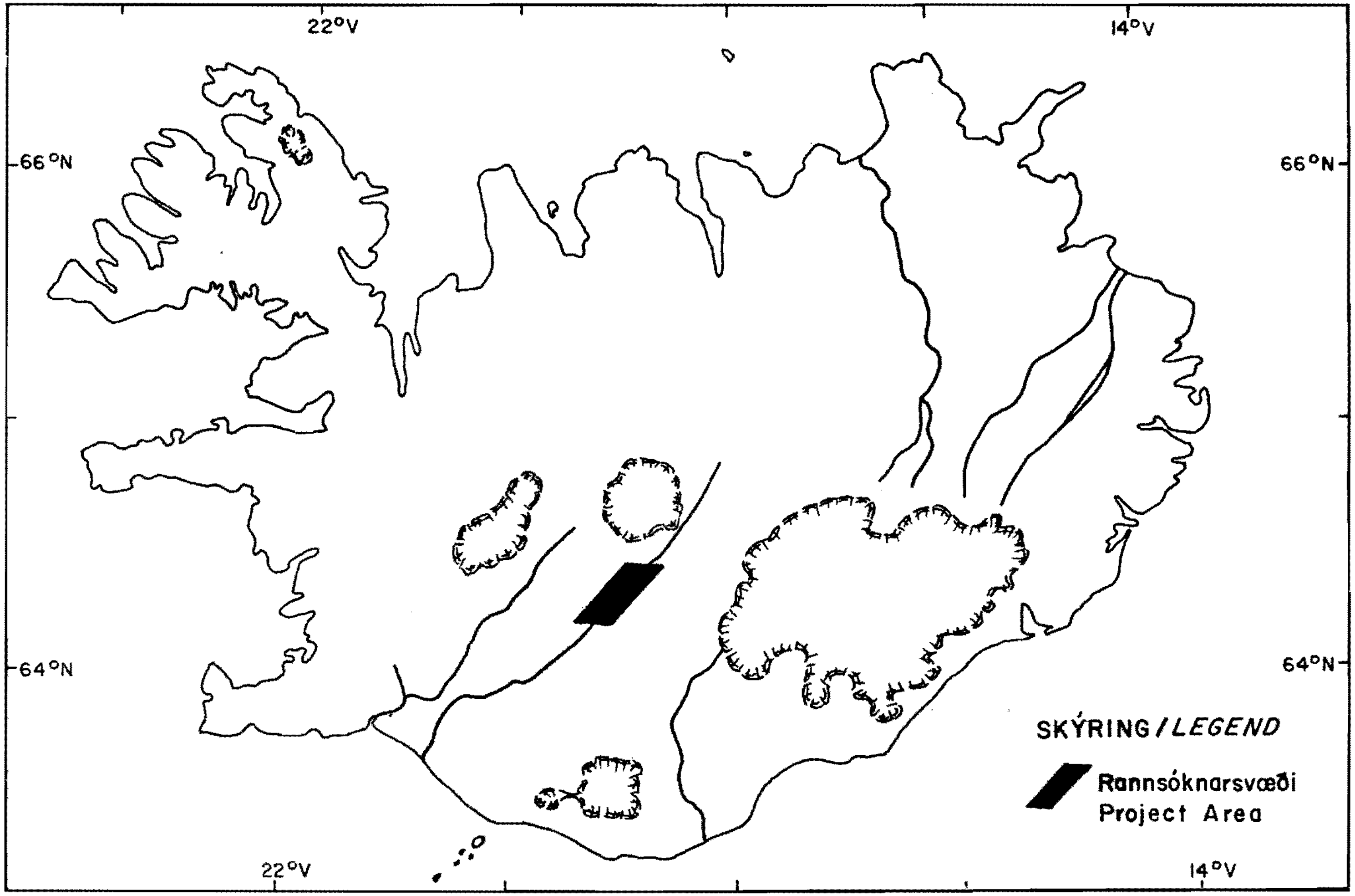
1 LU = Lugeon Unit = 1 l/min/m in 76 mm Ø hole at pressure 10 kg/cm^2

Hæðartölur jarðvatns eru ritaðar smærra letri en hæðartölur bergs, á borholusniðum.

Figures for ground water levels are shown with smaller lettering on graphic core logs.

Kjarni: Tölur sýna kjarnaheimtur í %
÷ kjarnataka ekki reynd.

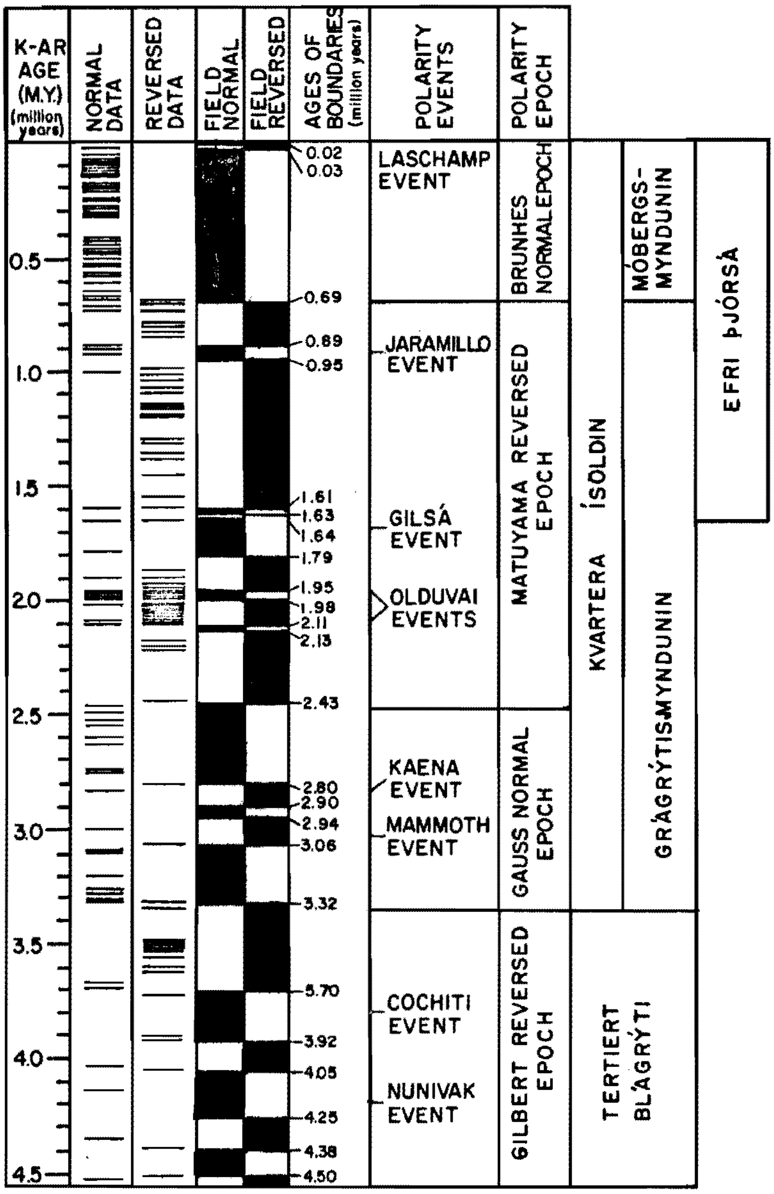
Core: Numbers indicate % core recovery
÷ core sampling not attempted.



Mynd / *Exh.* 1

Gnúpverjavirkjun, yfirlitskort / *Location Map*

MYND 2
EXH.



Segultímabil, skautaskipti segulsviðsins
Polarity epochs (A. Cox, 1969)

Mynd, Exh. 3

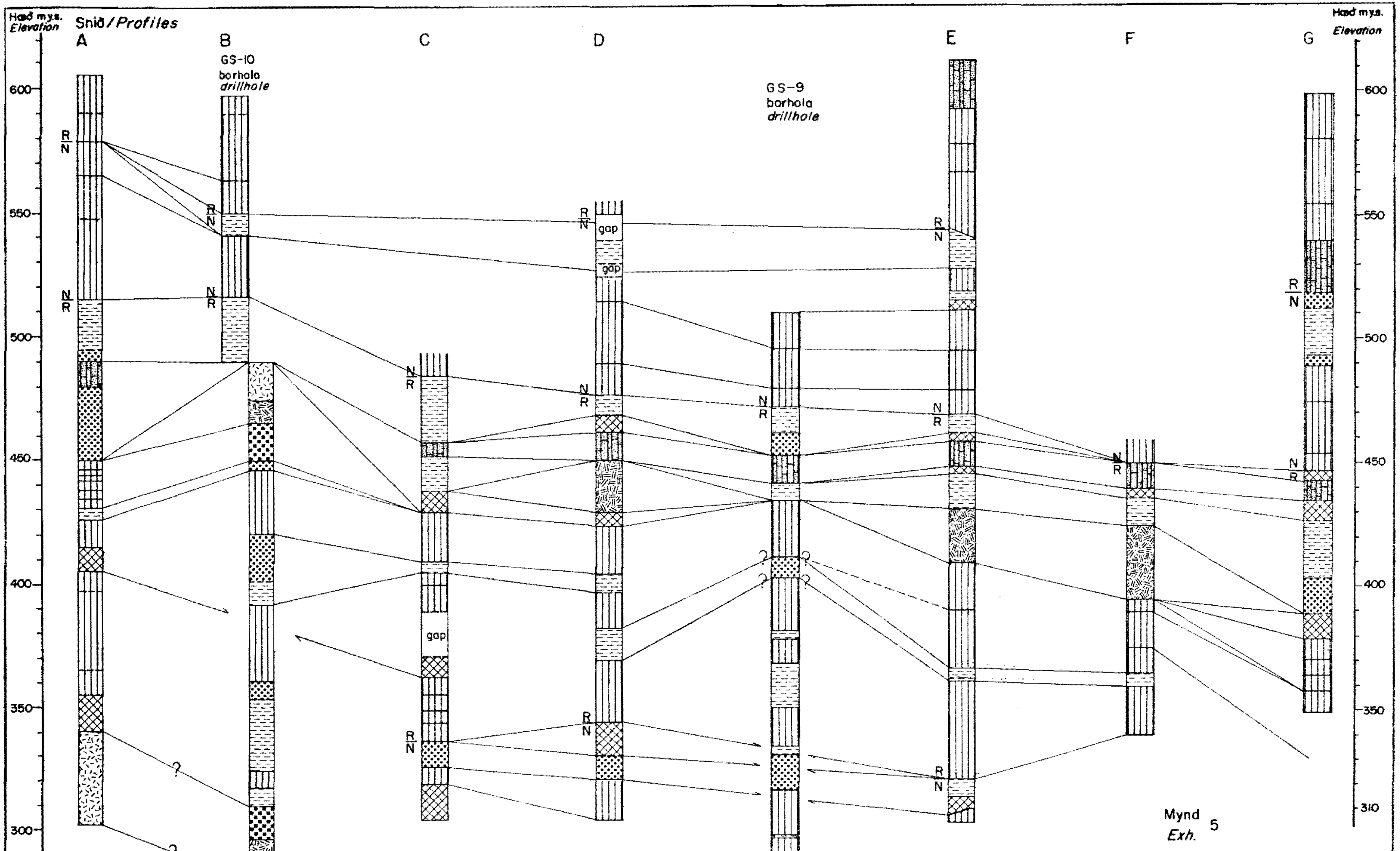
No.	Coordinates Y m.	X m.
Ⓐ	440113,94	546291,38
Ⓑ	439888,74	546988,89
Ⓒ	439974,06	547783,84
Ⓓ	439866,53	548036,55
Ⓔ	437545,74	552479,15
Ⓕ	436241,28	553794,16
Ⓖ	436412,55	554798,29
Ⓗ	435361,27	555578,11
Ⓘ	433681,47	555864,81
Ⓙ	433265,13	556153,71
Ⓚ	430742,42	557590,05
Ⓛ	429771,31	558108,00
Ⓜ	428379,39	560541,50
Ⓝ	426686,96	561732,26
Ⓞ	426392,18	563027,98
Ⓟ	426083,39	563255,03
Ⓠ	425564,54	563311,64
Ⓡ	425224,85	563482,05
Ⓢ	424049,09	563770,64
Ⓣ	423679,27	564039,88
[U]	434958,95	555406,66
[V]	434261,99	555864,8
[Z]	433428,68	555689,59
[Þ]	434679	554992

ORKUSTOFNUN

GNÚPVERJAVIRKJUN
Staðsetningarkort þversniða, langskurða, borhola og borroborana
Locationmap of sections, borholes and borrosoundings

T.10.11.'72 SvÞ/SL	Tnr. 37	Fnr. 10800
	B-331	


Mynd 4
Exh.
SKÝRINGAR / LEGEND
Dílótt basalt
Porphyritic basalt
Basalt, rétt segulmagnað
Basalt, normal magnetic
Basalt, öfugt segulmagnað
Basalt, reverse magnetic
Setberg, völuberg, jökulberg og sandsteinn
Sedimentary rock, conglomerate, tillite and sandstone
Móberg, öfugt segulmagnað
Móberg, reverse magnetic
Móberg, rétt segulmagnað
Móberg, normal magnetic
Stefna jökulráka / Direction of striations
Sprungur / Joints
Misgengi / Fault
Óviss tenging / Uncertain correlation
Gangur (við Hölknd) / Dike
Lind / Spring
Borhola
Borehole
N
Þjórsá
Hvanngiljafoss
GS-9
GS-10
0
1
2 km
ORKUSTOFNUN
GNÚPVERJAVIRKJUN
Jarðfræðikort / Geological Map
15.9.'72 Sv.Þ/IS.
Tnr. 33
B-331
Fnr. 10726



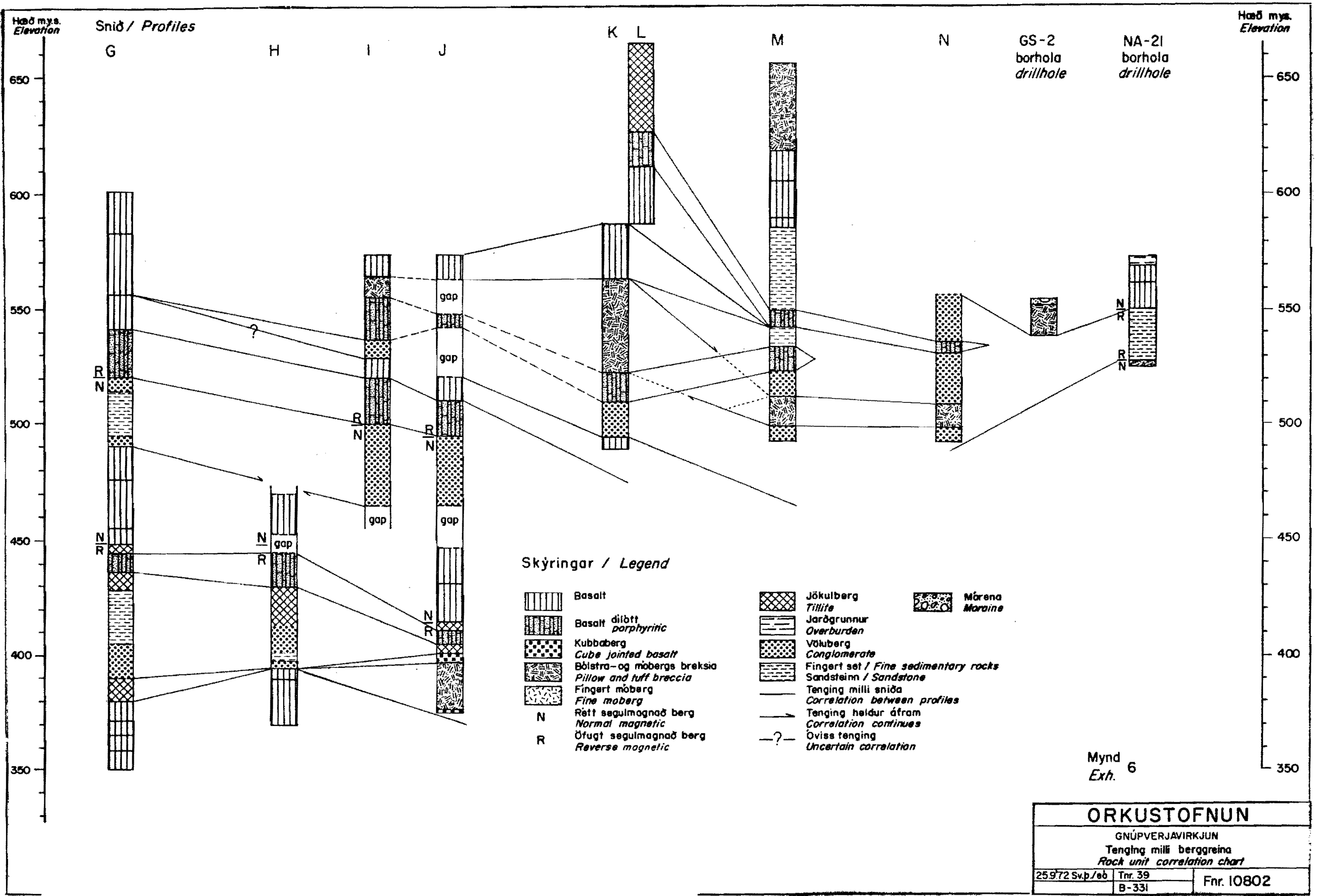
ORKUSTOFNUN

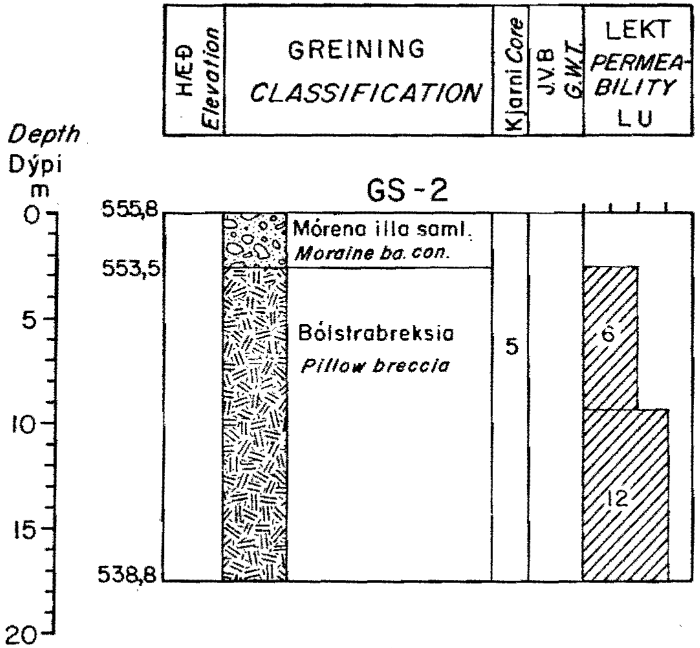
GNÚPVERJAVIRKJUN

Tenging milli berggreina

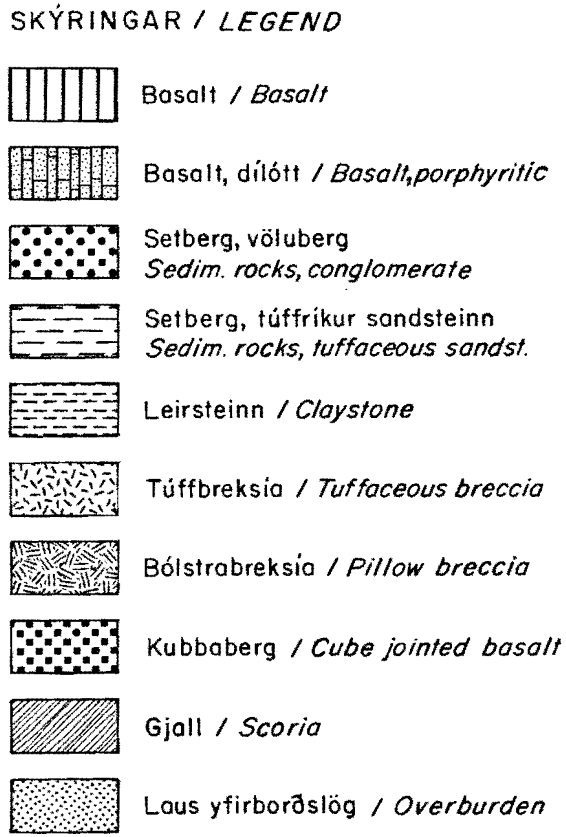
Rock unit correlation chart

25.9.72 Sv.Þ./eó	Tnr. 38 B-331	Fnr. 10801


Hæð m.y.s.
Elevation
Snið / Profiles
G
H
I
J
K
L
M
N
GS-2
borhola
drillhole
NA-21
borhola
drillhole
650
600
550
500
450
400
350
gap
?
R
N
Skýringar / Legend
Basalt
Basalt dílótt porphyritic
Kubbaberg
Cube jointed basalt
Bólstra- og mobergs breksia
Pillow and tuff breccia
Fingert móberg
Fine moberg
Rétt segulmagnað berg
Normal magnetic
Öfugt segulmagnað berg
Reverse magnetic
Jökulberg
Tillite
Jarðgrunnur
Overburden
Völuberg
Conglomerate
Fingert set / Fine sedimentary rocks
Sandsteinn / Sandstone
Tenging milli sniða
Correlation between profiles
Tenging heldur áfram
Correlation continues
Óviss tenging
Uncertain correlation
Mórena
Moraine
Mynd 6
Exh.
ORKUSTOFNUN
GNÚPVERJAVIRKJUN
Tenging milli berggreina
Rock unit correlation chart
25.9.72 Sv.þ./eð
Tnr. 39
B-331
Fnr. 10802



Staðsetning, sjá Mynd 3
Location, see Exh.



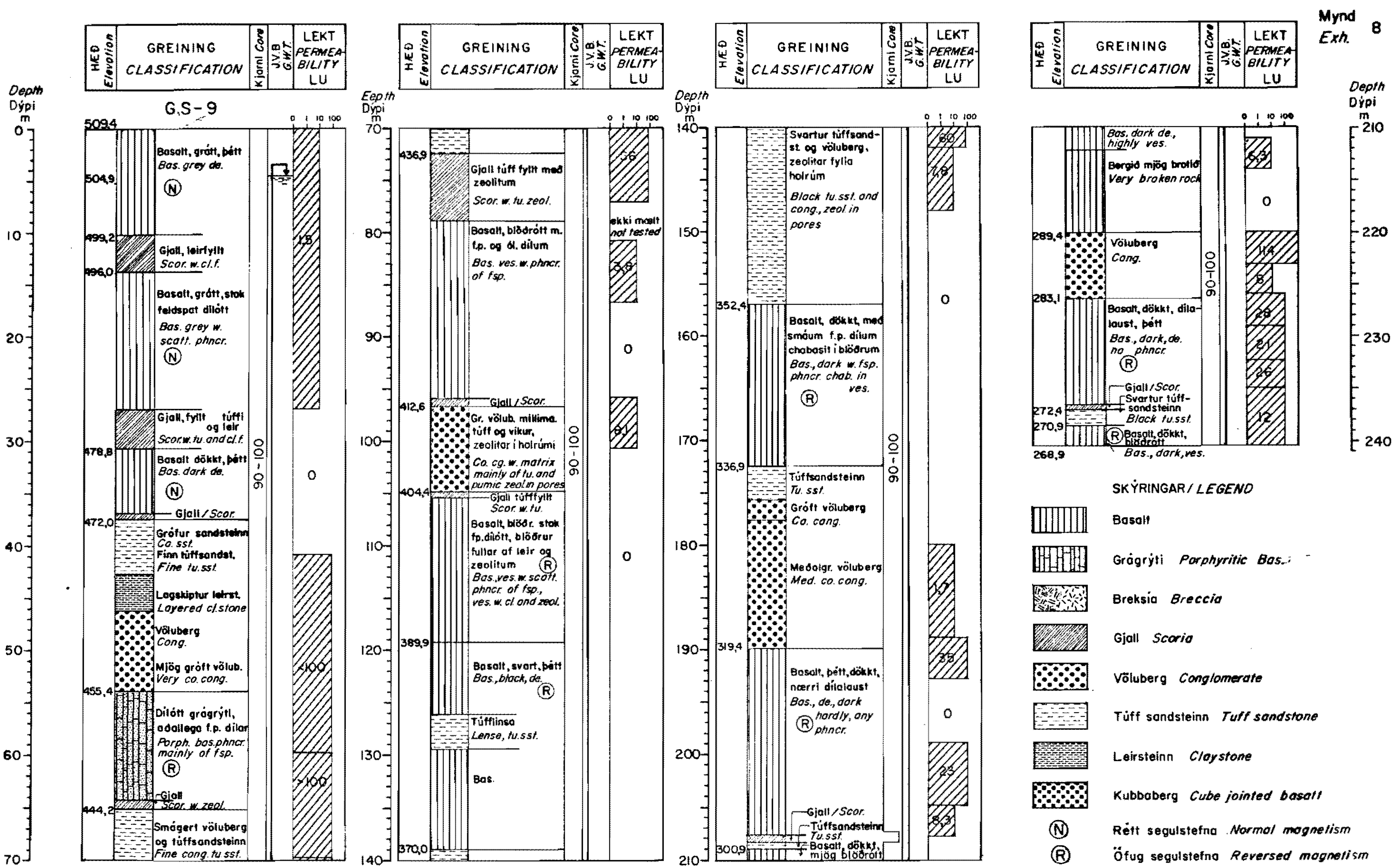
ORKUSTOFNUN

GNÚPVERJAVIRKJUN

Borholusnið, GS-2, og skýringar við borholusnið
Graphic core log GS-2, and legend for core logs

Mynd 7
Exh.

3.10.'72 Sv.Þ/IS.
Tnr. 41
B-331
Fnr. 10804



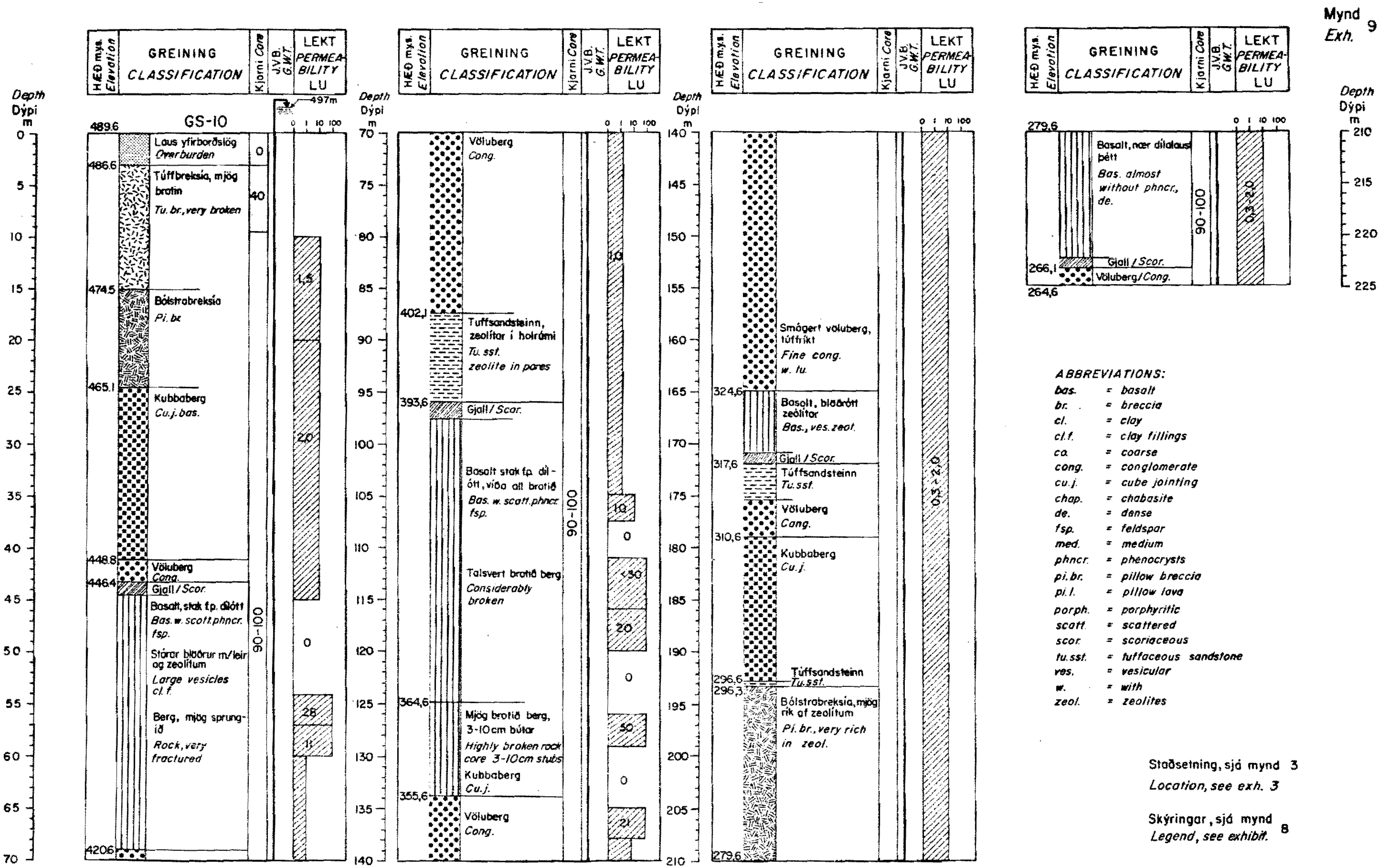
Staðsetning, sjá mynd 3
Location, see exh. 3

Skammstafanir, sjá mynd 9
Abbreviations, see exh. 9

ORKUSTOFNUN

GNÚPVERJAVIRKJUN
Snið af borholum GS-9
Graphic core log GS-9

6.10.'72 SVÞ/HB | Tnr. 42 | Blað 1 af 3 | B-331 | Fnr. 10805

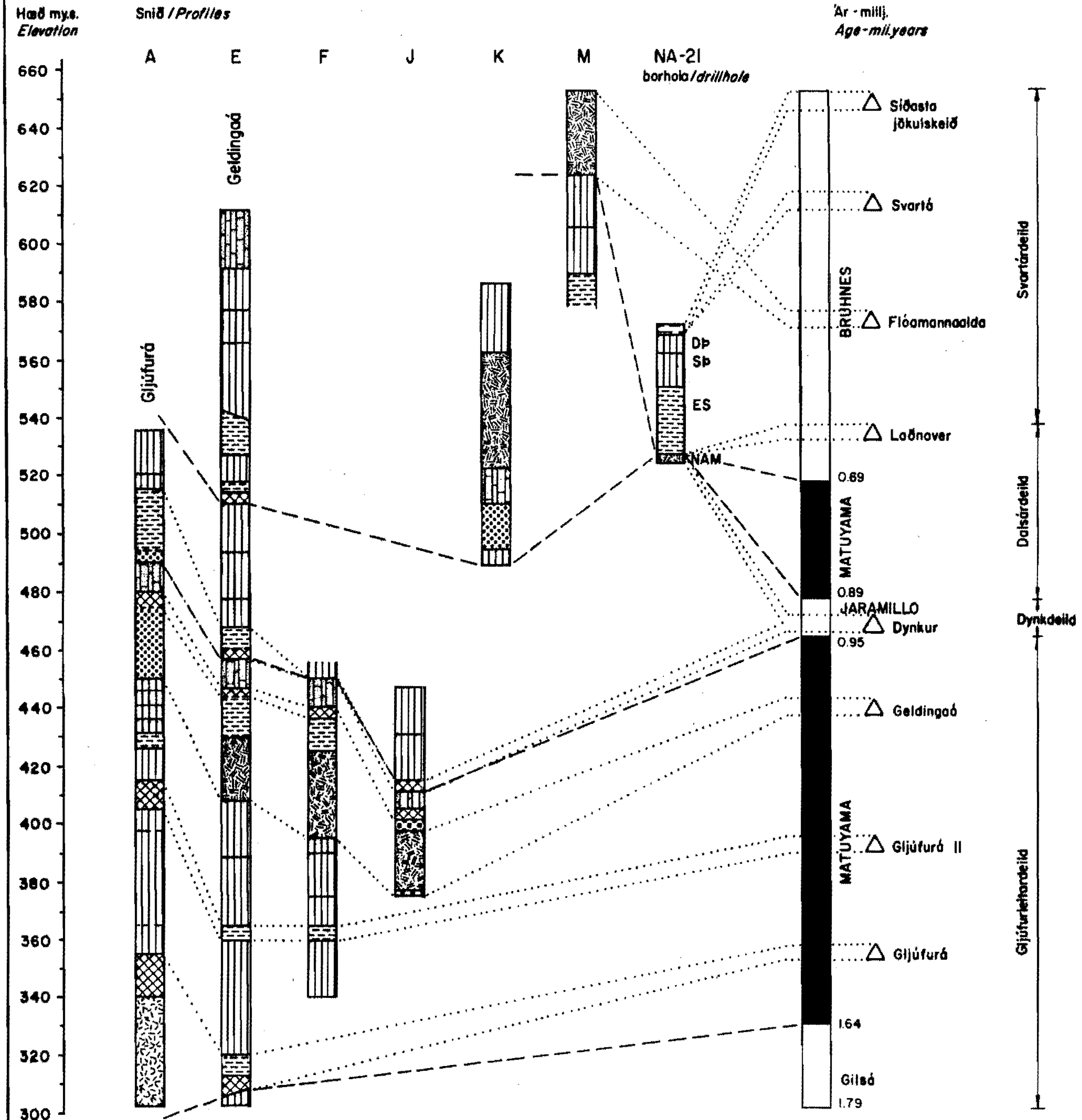


Jarðvatnsborðið er um 7m fyrir ofan holustút í ~497m hæð.

The groundwatertable is about 7m above the top of the hole at ~497m el.

ORKUSTOFNUN	
GNÚPVERJAVIRKJUN	
Snið af borholum GS-10 / *Graphic core log GS-10*	
25.9.72 Svþ./eb Tnr. 43 B-331	Fnr. 10806

Mynd
Exh. 10



Skýringar, sjá mynd 6
Legend, see exhibit. 6

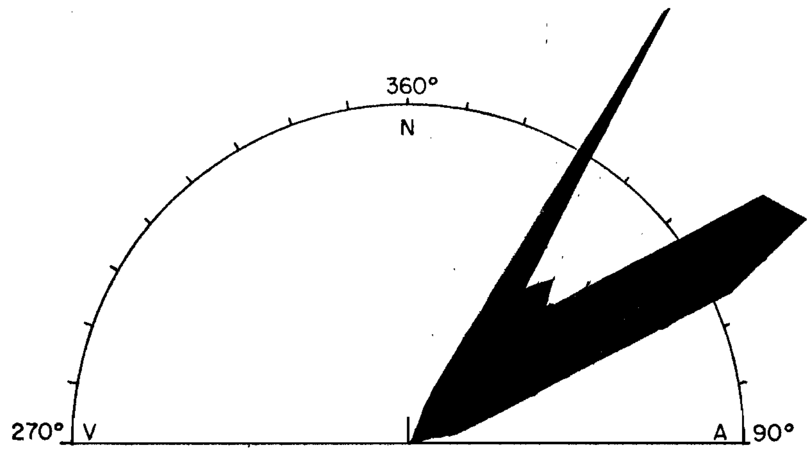
ORKUSTOFNUN	
GNÚPVERJAVIRKJUN	
Tenging jarðlagasniða	
Correlation between geological sections	
25.9.72 Sv.Þ./eö · Tnr. 40 · B-331	Fnr. 10803

Mynd II
Exh.

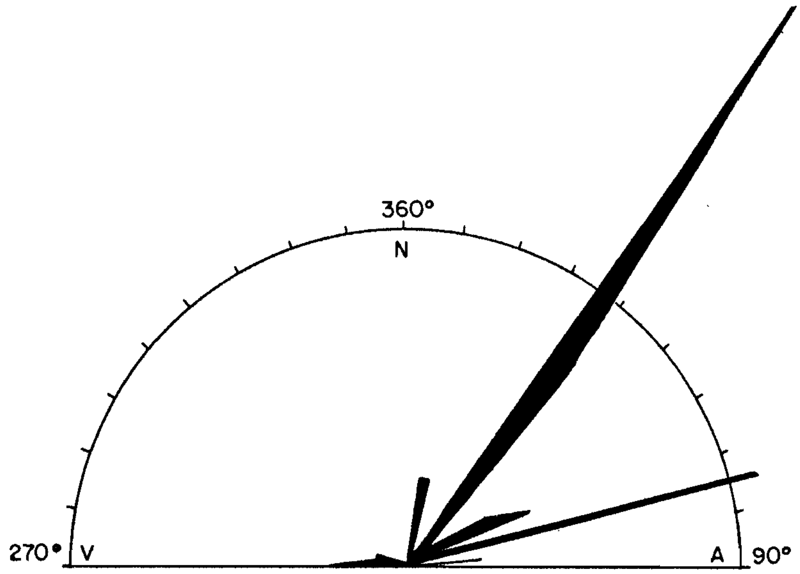
ORKUSTOFNUN
GNÚPVERJAVIRKJUN
Jarðgrunnskort / Map of Superficial Deposits

25.9.'72 Sv.Þ/IS	Tnr. 32	Fnr. 10672
	B-331	

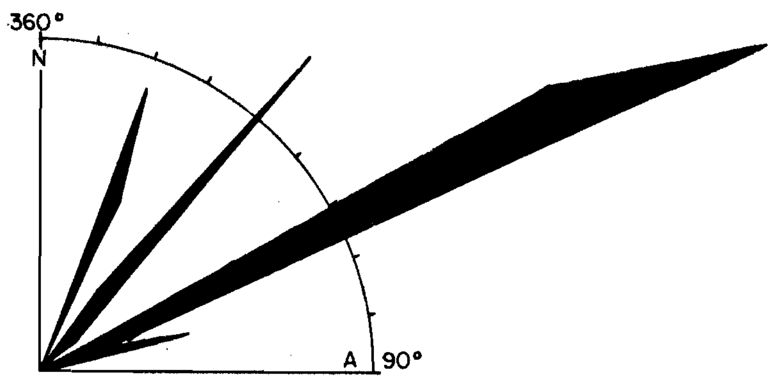
Mynd 12
Exh.



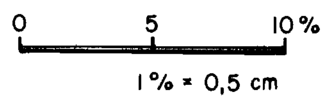
A. Gljúfurá – Dalsá



B. Dalsá – inn fyrir Kisu

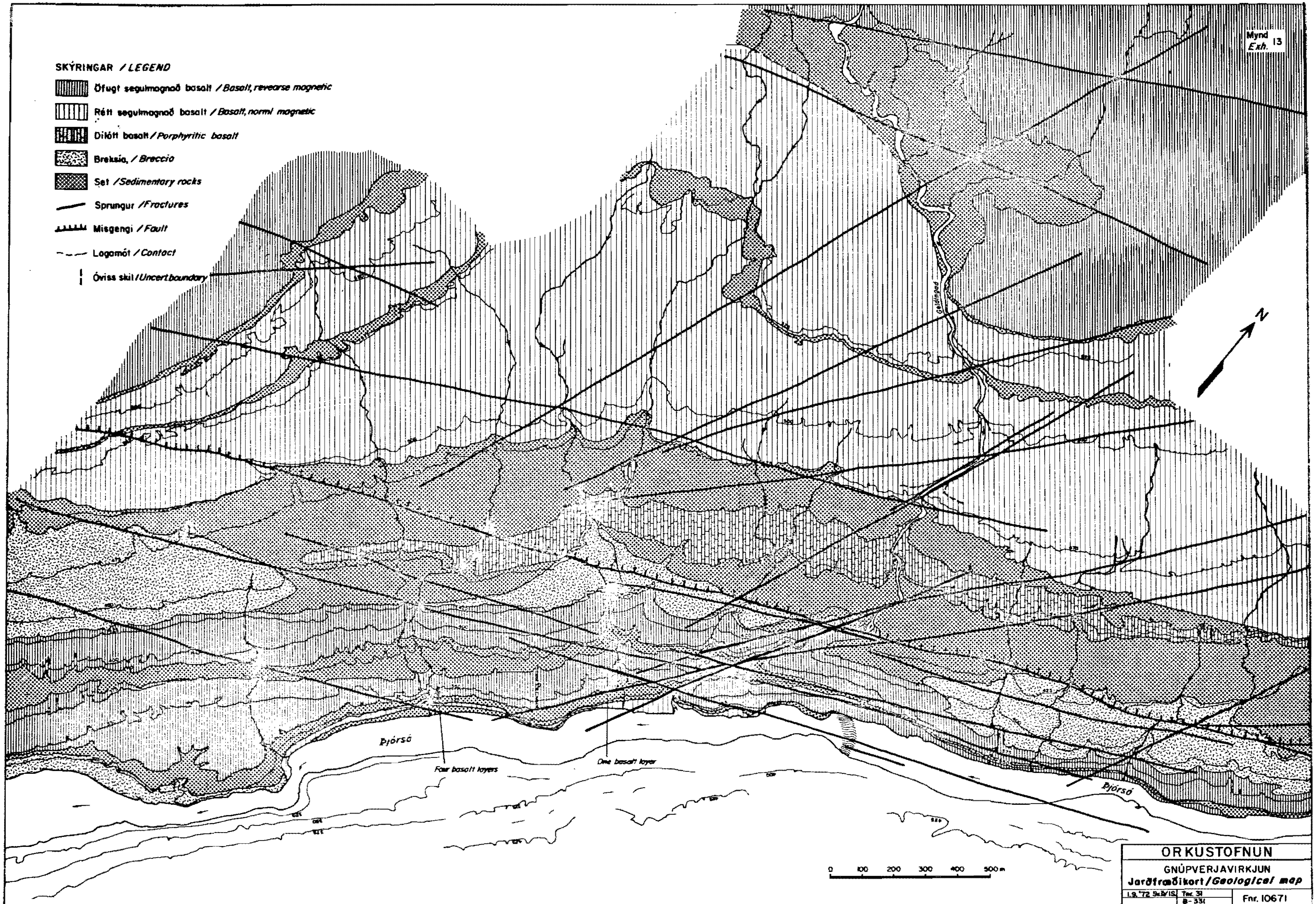


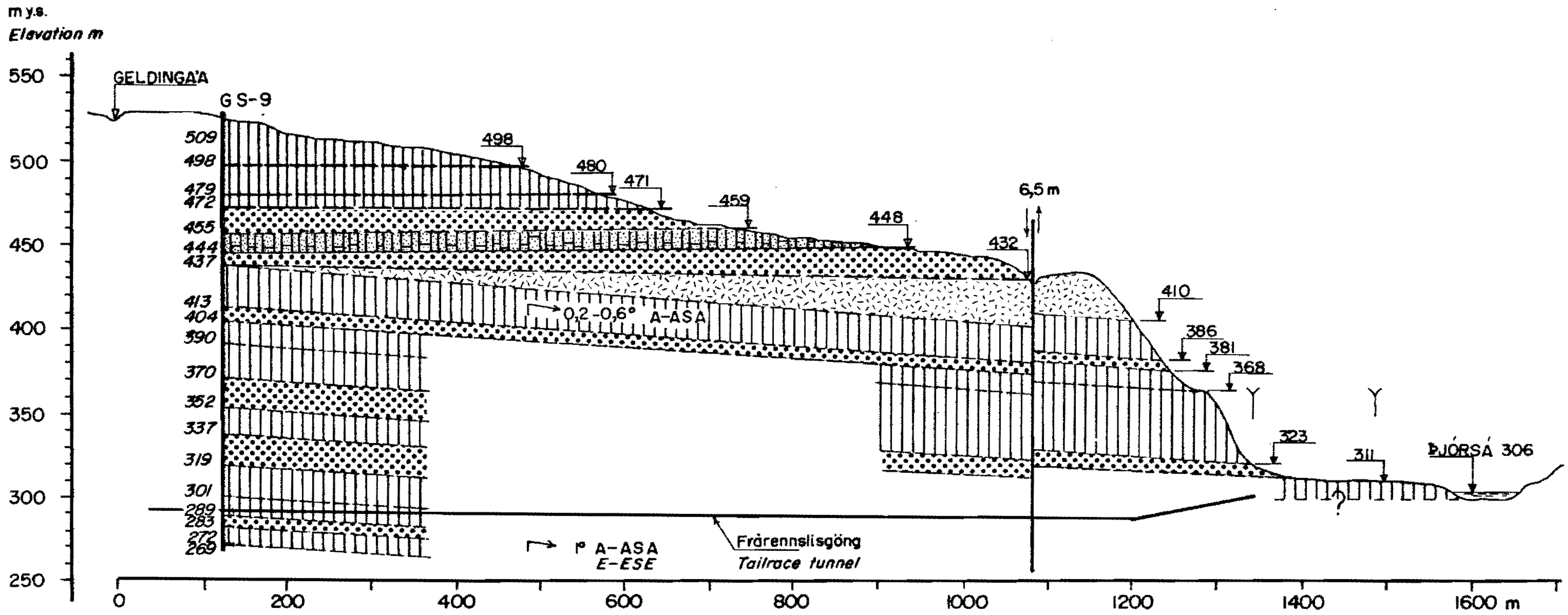
C. Gljúfurleit



Sprungur settar inn fyrir hverjar 5°
Plotted to the nearest 5°

ORKUSTOFNUN		
GNÚPVERJAVIRKJUN		
Sprungurósir/*Fracture rose diagrams*		
21.9'72. Sv.Þ/EK	T-34 B-331	Fnr. 10797


Mynd 13
Exh.
SKÝRINGAR / LEGEND
Öfugt segulmognoð basalt / Basalt, revearse magnetic
Rétt segulmognoð basalt / Basalt, norml magnetic
Dílótt basalt / Porphyritic basalt
Breksía, / Breccia
Set / Sedimentary rocks
Sprungur / Fractures
Misgengi / Fault
Lagamót / Contact
Óviss skil / Uncert.boundary
N
Geldingað
Þjórsá
Four basalt layers
One basalt layer
Þjórsá
0 100 200 300 400 500 m
ORKUSTOFNUN
GNÚPVERJAVIRKJUN
Jarðfræðikort / Geological map
Fnr. 10671



SKÝRINGAR / *LEGEND*

Basalt / *Basalt*

Setberg / *Sedimentary rocks*

Breksia og kubbaberg
Breccia and cube jointed basalt

Dílótt basalt / *Porphyritic basalt*

6,5 m Misgengi
Fault

498 Hæð lagamóta / *Elev. of contacts*

Snið beygir / *Section turns*

Óviss tenging / *Uncertain correlation*

GS-9 Borhola GS-9 / *Drillhole GS-9*

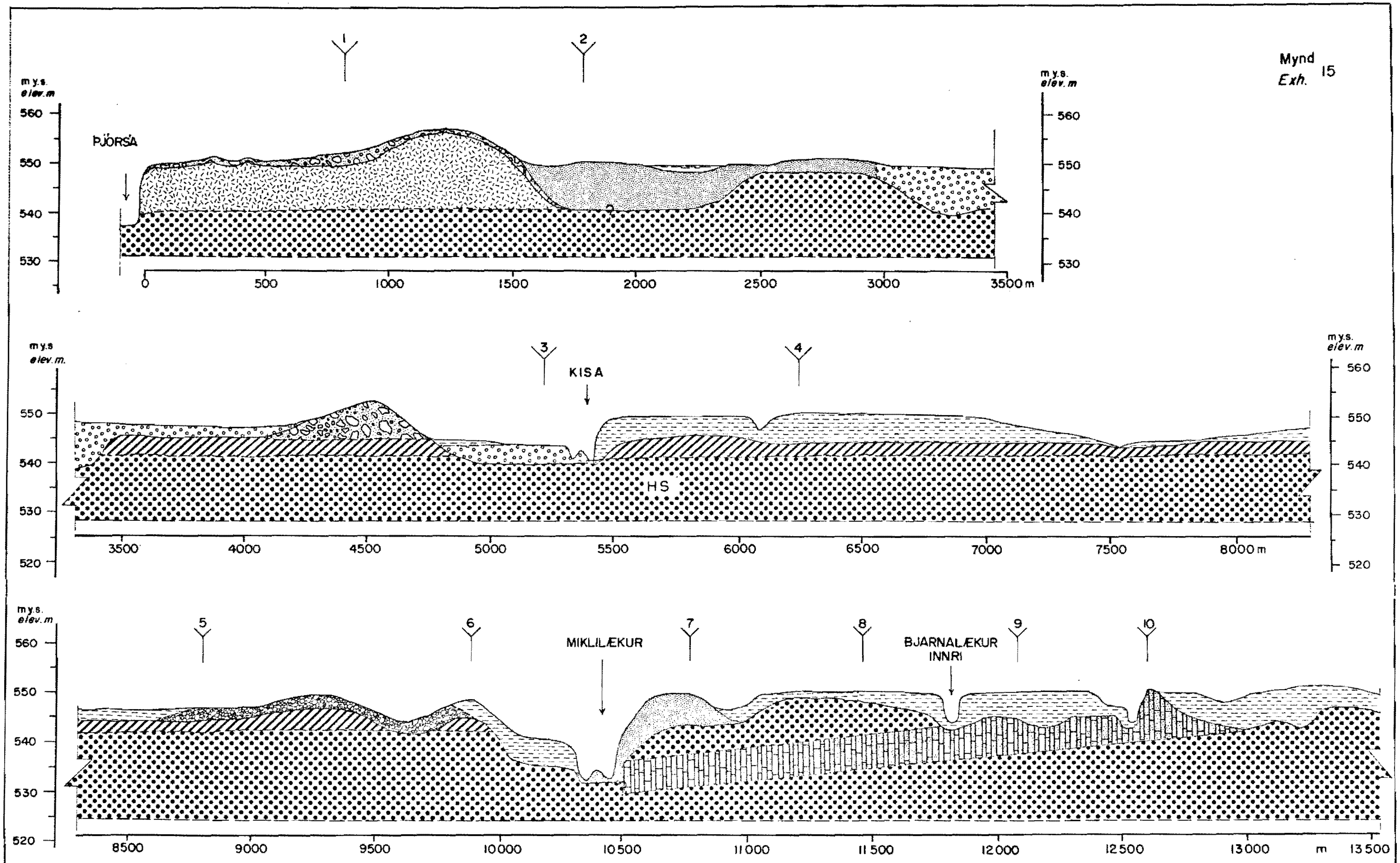
Hámarks halli / *Maximum slope*

ORKUSTOFNUN

GNÚPVERJAVIRKJUN
ÞJÓRSÁ–GS-9
Þversnið / *Section*

Mynd 14
Exh.

29.9.'72 Sv.Þ/eó	
Tnr. 44	
B-331	
Fnr. 10807	



ORKUSTOFNUN

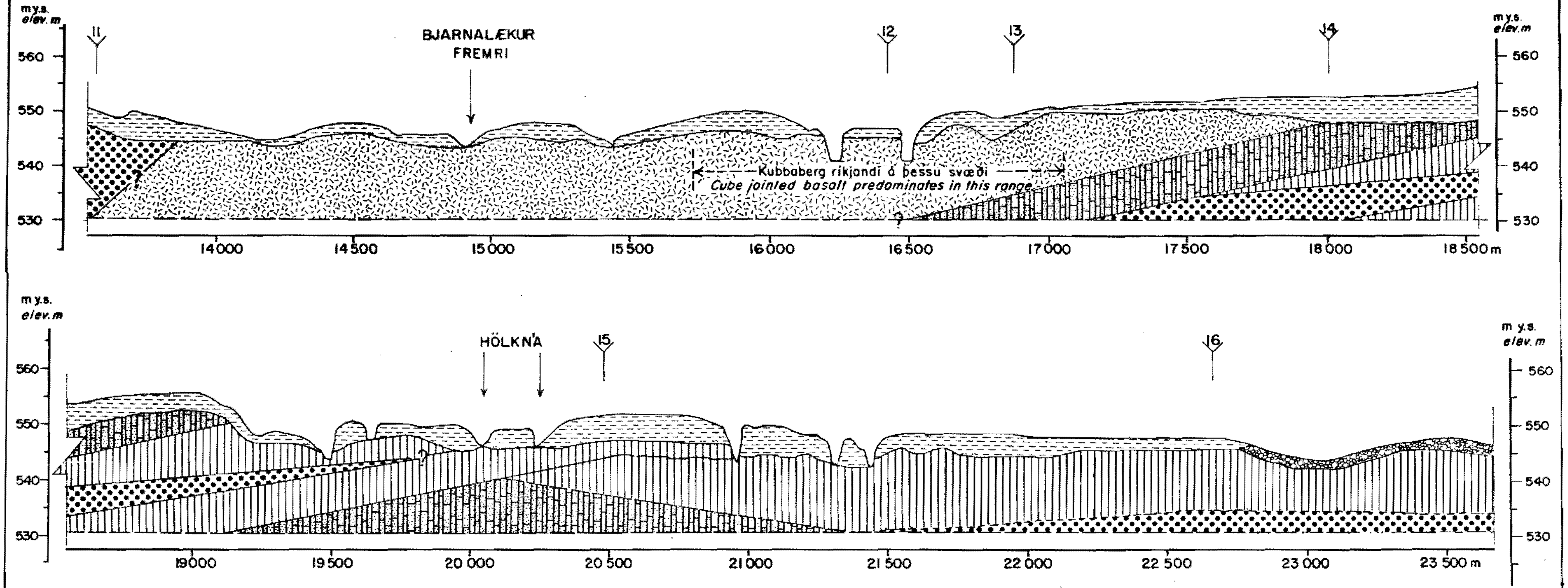
GNÚPVERJAVIRKJUN

EFRI-ÞJÓRSÁ

Skurðleið, langsnið / *Canal-Longitudinal section*

26.9.'72 Sv.Þ/	Tnr. 45	Fnr. 10808
Blað 1 af 2	B-331	

Mynd *Exh.* 15

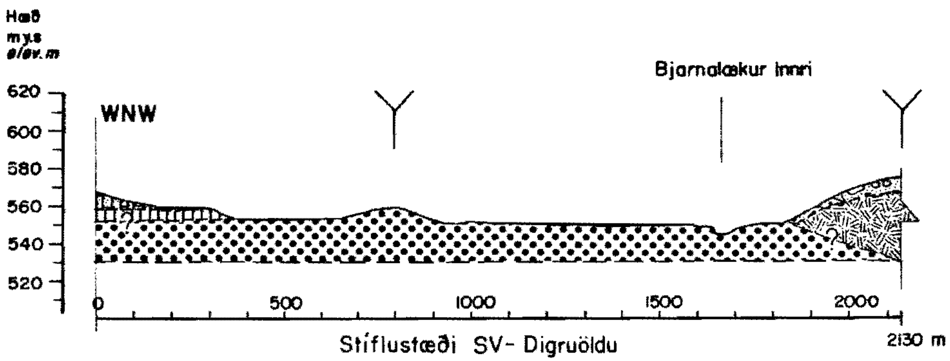


SKÝRINGAR / *LEGEND*

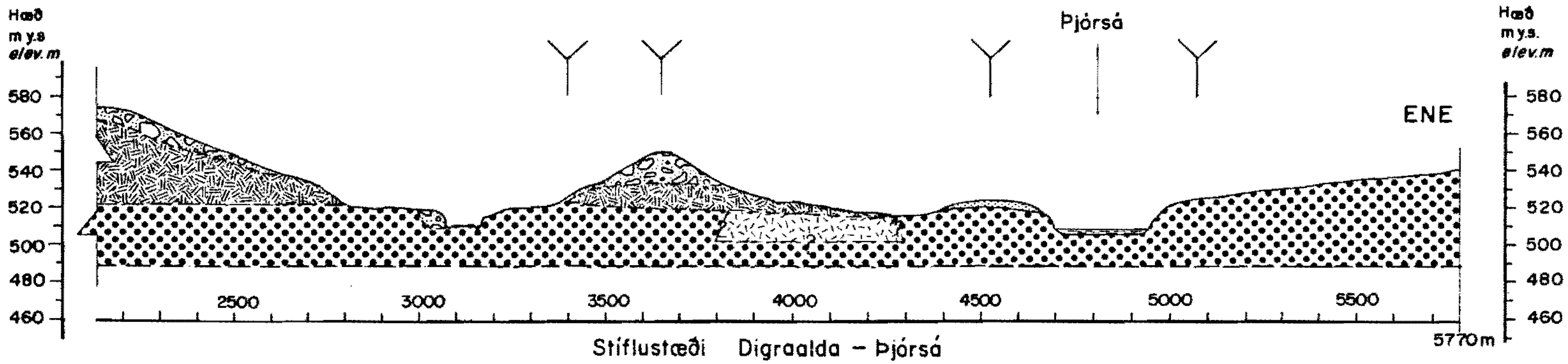
- HS Setberg, völuberg og sandsteinn — *Sedimentary rocks, conglomerate and sandstone*
- Breksía — *Breccia*
- Sandur og fín möl — *Sand and fine gravel*
- Jökulruðningur — *Moraine*
- Basalt — *Basalt*
- Basalt, brotið — *Basalt, broken up*
- Jarðvegur — *Soil*
- Dílótt basalt — *Porphyritic basalt*
- Fíngert, líparítríkt völuberg — *Fine rhyolite rich conglomerate*
- Urð, melur — *Gravel hillocks, bouldery*
- ? Óviss lagskil — *Uncertain contact*
- Snið beygir — *Section turns*
- 6 Númer á beygju — *Number of turn*

ORKUSTOFNUN	
GNÚPVERJAVIRKJUN EFRI-ÞJÓRSÁ Skurðleið/langsnið / *Canal-Longitudinal section*	
26.9.'72 Sv.Þ/ Tnr. 45	Fnr. 10808
Blað 2 of 2 B-331	

Mynd 16
Exh. —



Stíflustæði SV- Digruöldu
Damsite SW of Digraalda
O - O

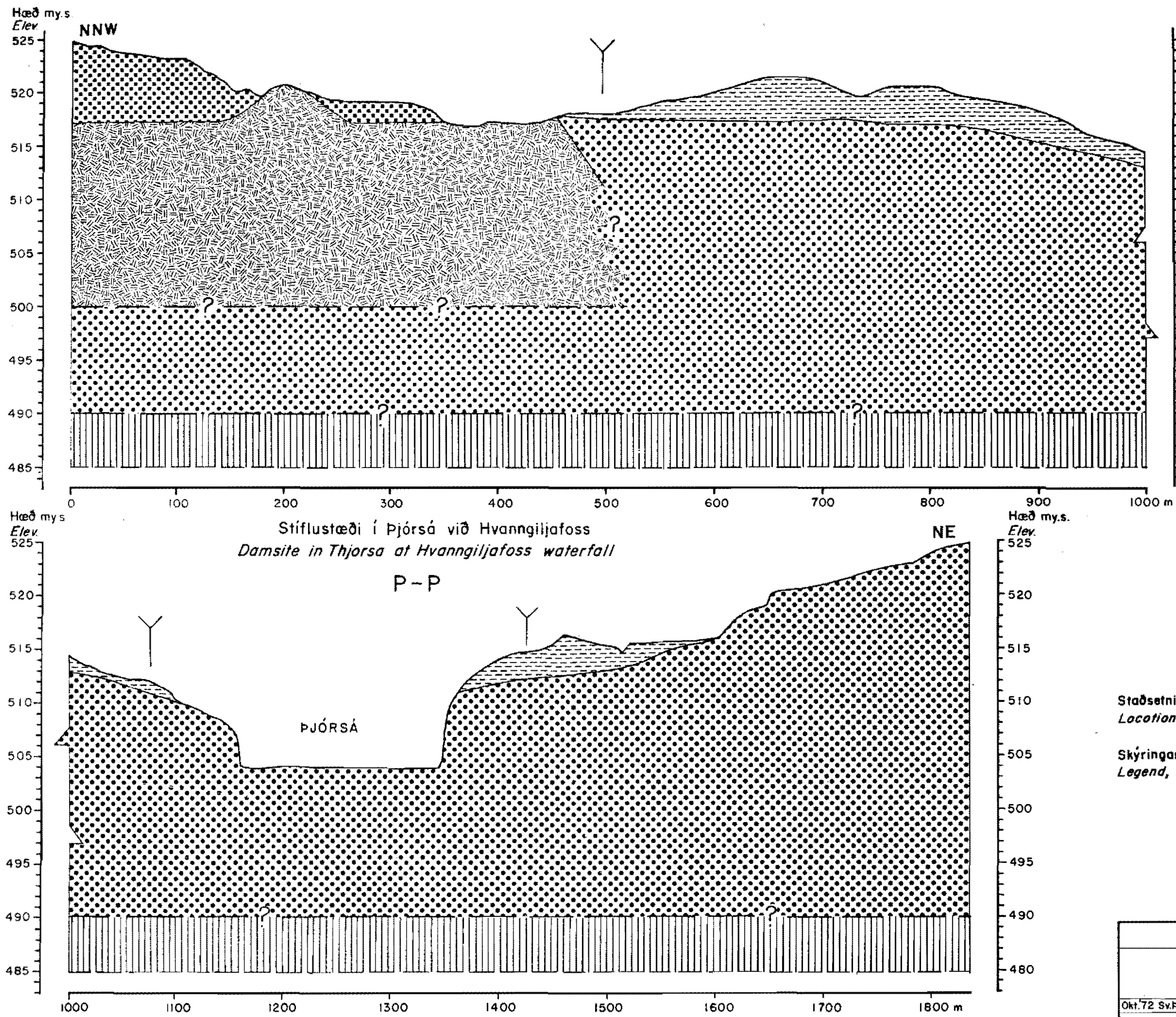


Stíflustæði Digraalda – Þjórsá
Damsite Digraalda – Thjorsa
O - O

Skýringar, sjà mynd 25
Legend, see exhibit 25

Staðsetning, sjá mynd 3
Location see exhibit 3

ORKUSTOFNUN		
GNÚPVERJAVIRKJUN Jarðlagasnið O–O *Geological section O-O*		
Okt.'72 Sv.Þ/	Tnr. 46 B-331	Fnr. 10833



Mynd 17
Exh. –"–

Staðsetning, sjá mynd 3
Location, see exhibit 3

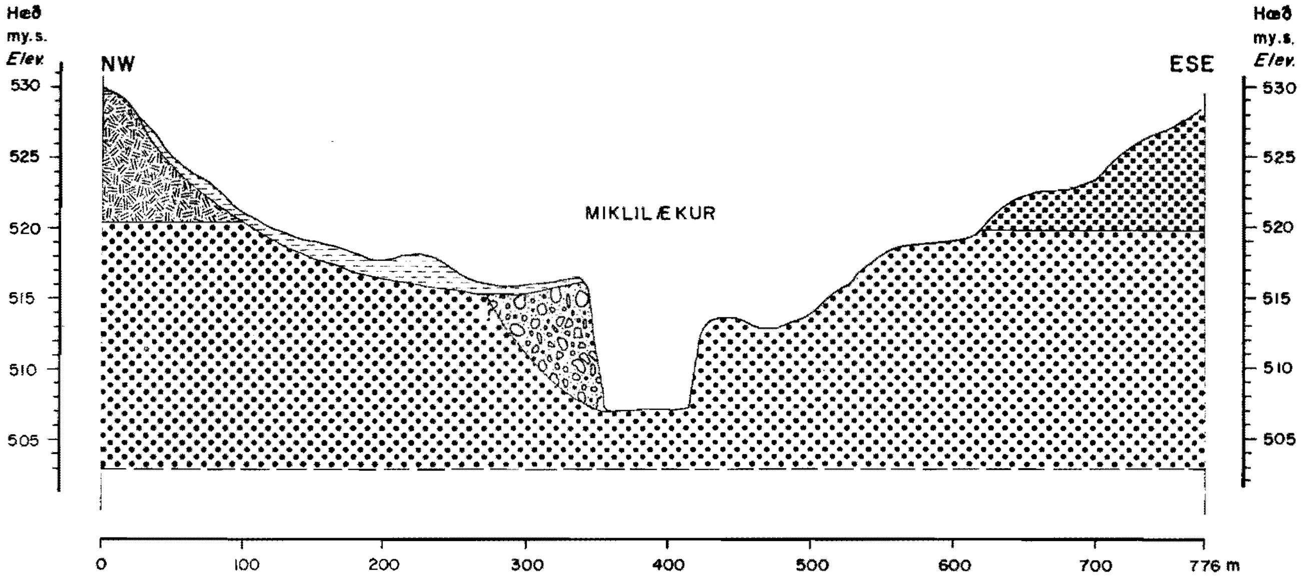
Skýringar sjá mynd 25
Legend, see exhibit 25

ORKUSTOFNUN

GNÚPVERJAVIRKJUN
Jarðlagasnið P – P
Geological section P – P

Okt.'72 Sv.P/Gyða	Tnr. 47 / B- 331	Fnr. 10834

Mynd 18
Exh. -"-



Stíflustæði í Miklalæk milli Kjálkavers og Digruöldu
Damsite in river Miklilækur between Kjálkaver and Digraalda

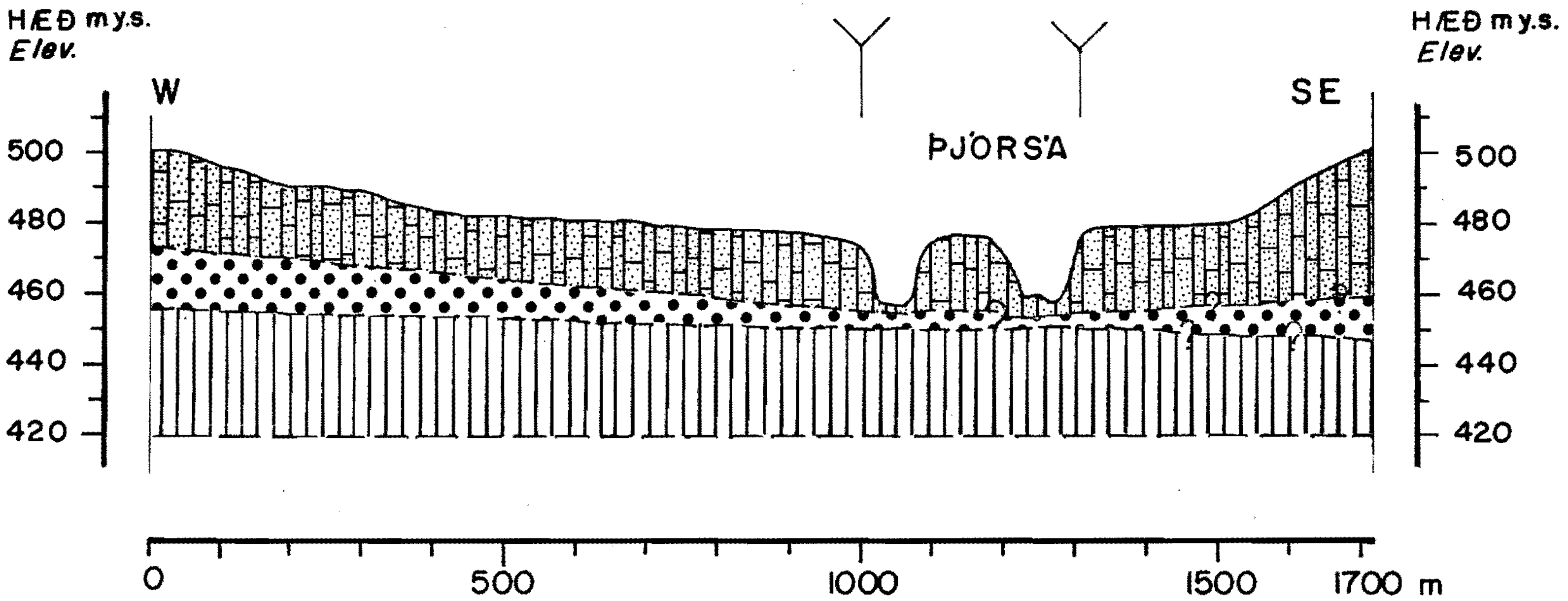
Q – Q

Staðsetning, sjá mynd 3
Location, see exhibit 3

Skýringar, sjá mynd 25
Legend, see exhibit 25

ORKUSTOFNUN		
GNÚPVERJAVIRKJUN Jarðlagasnið Q – Q *Geological section Q – Q*		
Okt.'72 Sv.Þ/eó	Tnr. 48 B-331	Fnr. 10835

Mynd 19
Exh. –"–



Stíflustæði Þjórsá við Krók

Damsite in Thjórsá river at Krókur

R – R

Staðsetning, sjá mynd 3

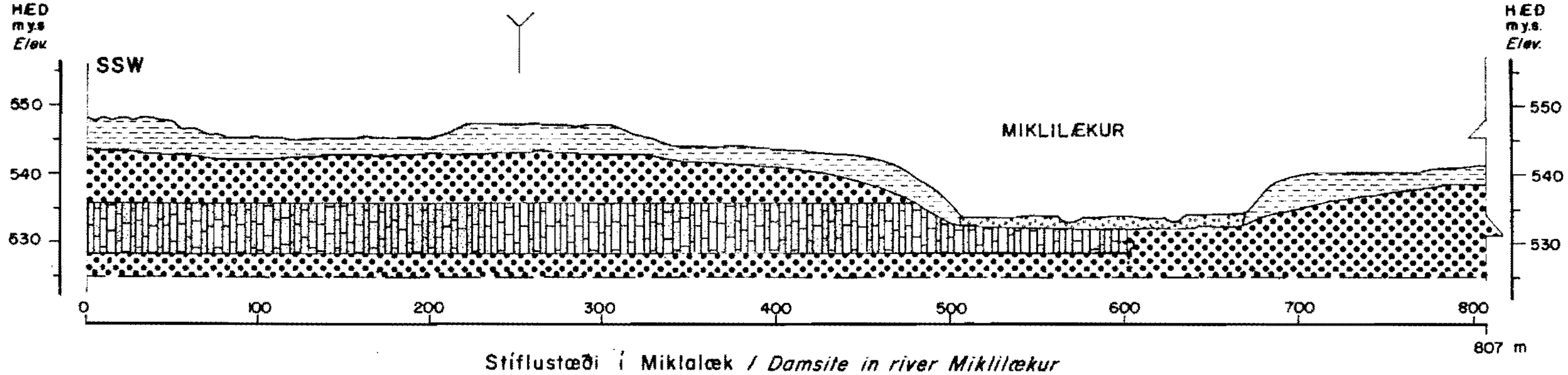
Location, see exhibit 3

Skýringar, sjá mynd 25

Legend, see exhibit 25

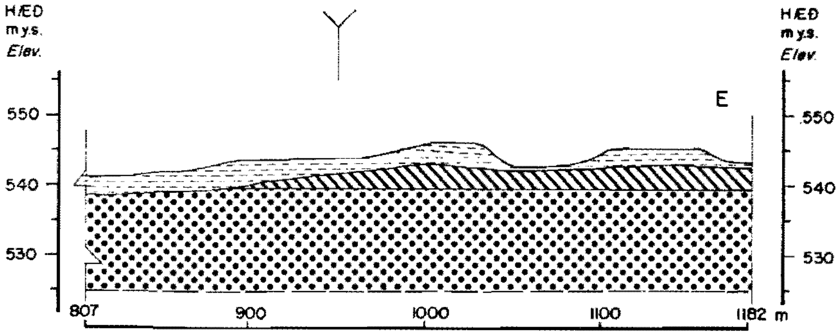
ORKUSTOFNUN		
GNÚPVERJAVIRKJUN Jarðlagasnið R – R *Geological section R – R*		
Okt.'72 Sv.P.	Tnr. 49 B – 331	Fnr. 10836

Mynd 20
Exh. –"–



Stíflustæði í Miklalæk / *Damsite in river Miklilækur*

S – S

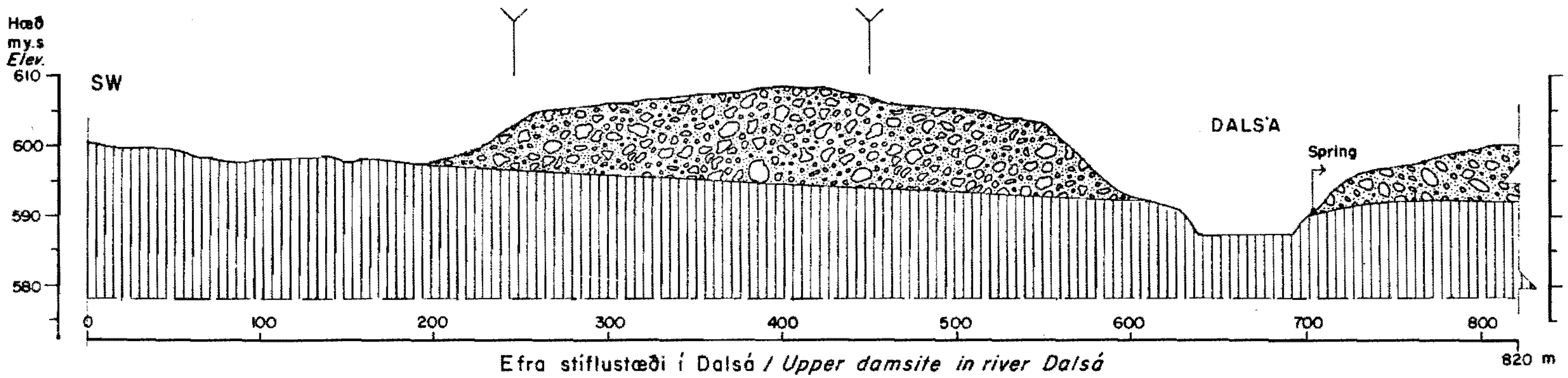


Staðsetning, sjá mynd 3
Location, see exhibit 3

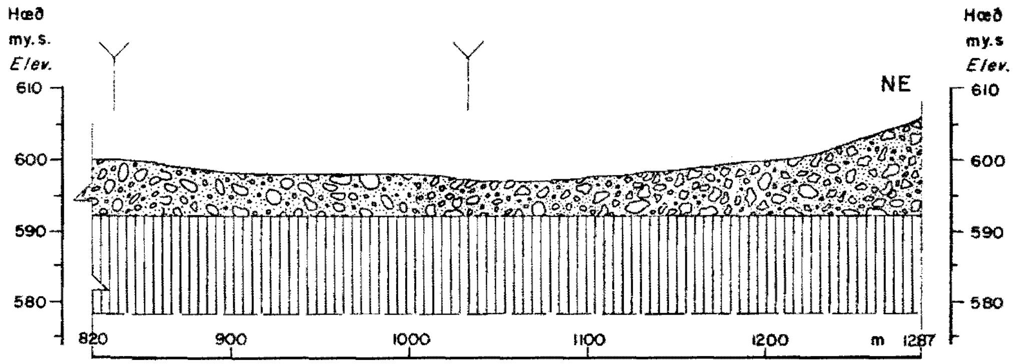
Skýringar, sjá mynd 25
Legend, see exhibit 25

ORKUSTOFNUN		
GNÚPVERJAVIRKJUN Jarðlagasnið S – S *Geological section S – S*		
Okt.'72 SvÞ/eó	Tnr 50 B-331	Fnr. 10837

Mynd 21
Exh. -"-



Efra stíflustæði í Dalsá / *Upper damsite in river Dalsá*
T - T

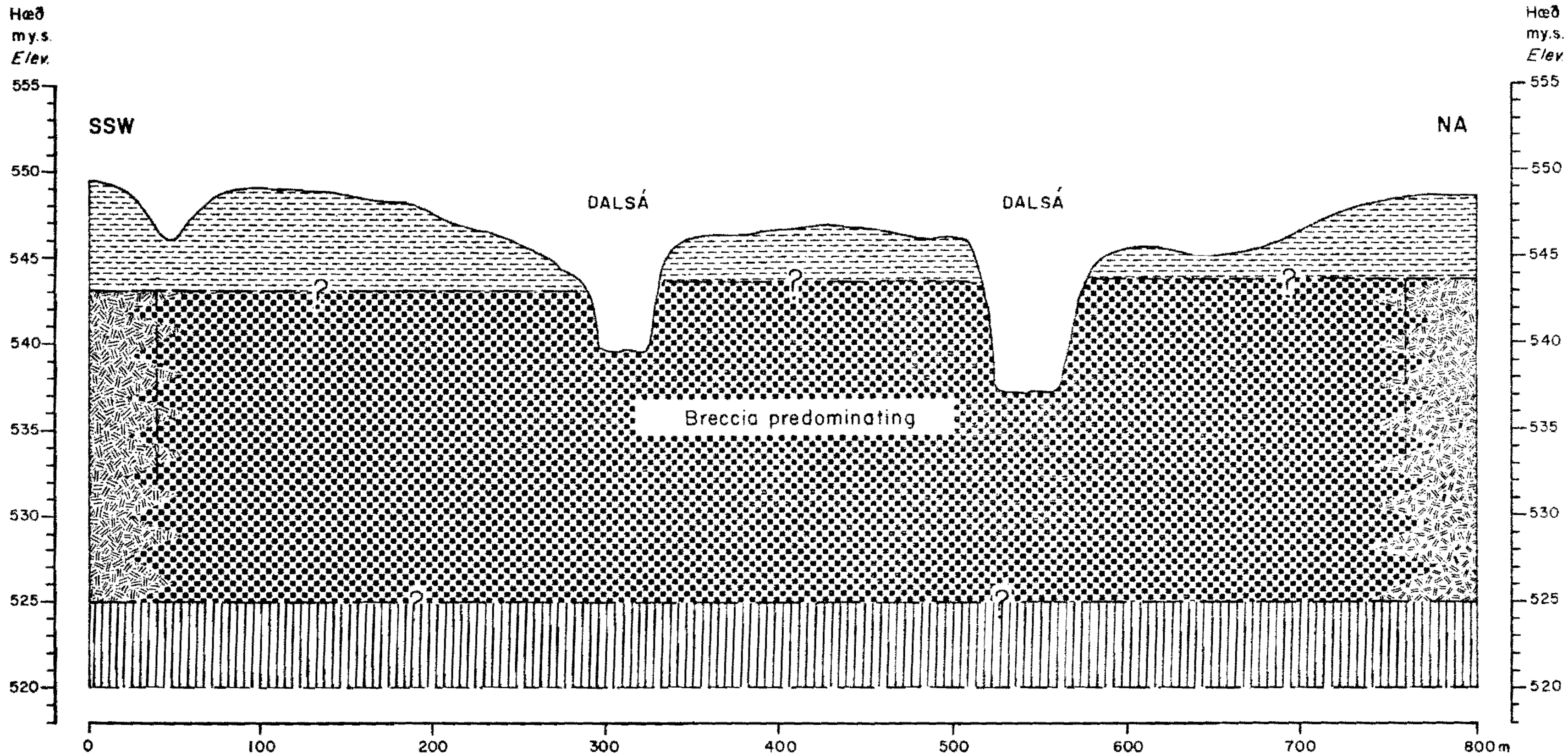


Staðsetning, sjá mynd 3
Location, see exhibit 3

Skýringar, sjá mynd 25
Legend, see exhibit 25

ORKUSTOFNUN		
GNÚPVERJAVIRKJUN Jarðlagasnið T-T *Geological section T-T*		
Okt '72 Sv.P./eó	Tnr. 51 B-331	Fnr.10838

Mynd 22
Exh. —"—



Stíflustæði í Dalsá
Damsite in river Dalsá

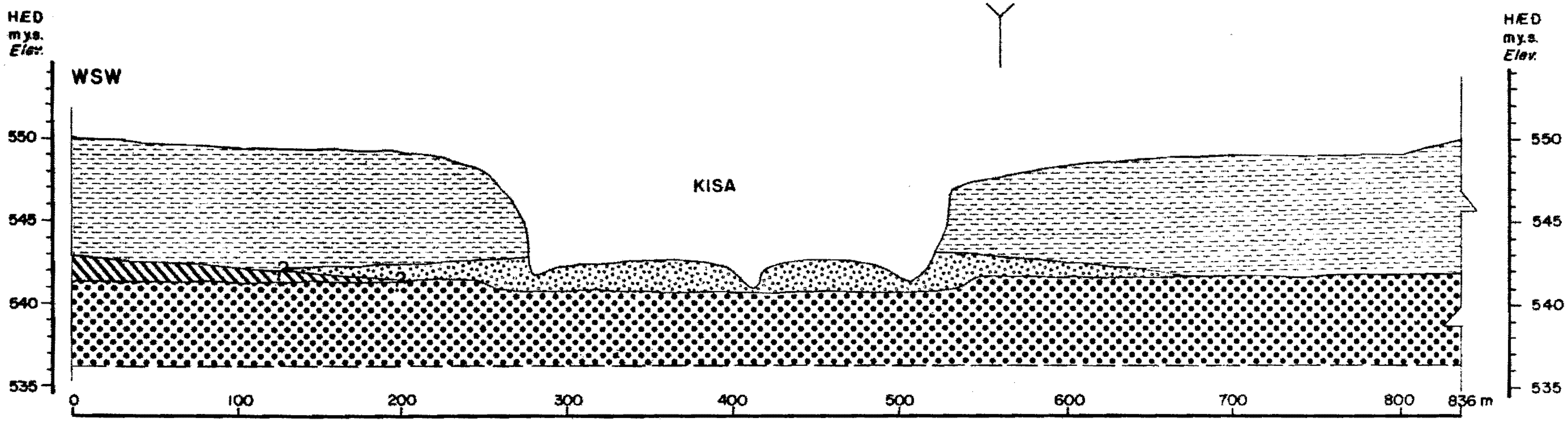
U – U

Staðsetning, sjá mynd 3
Location, see exhibit 3

Skýringar, sjá mynd 25
Legend, see exhibit 25

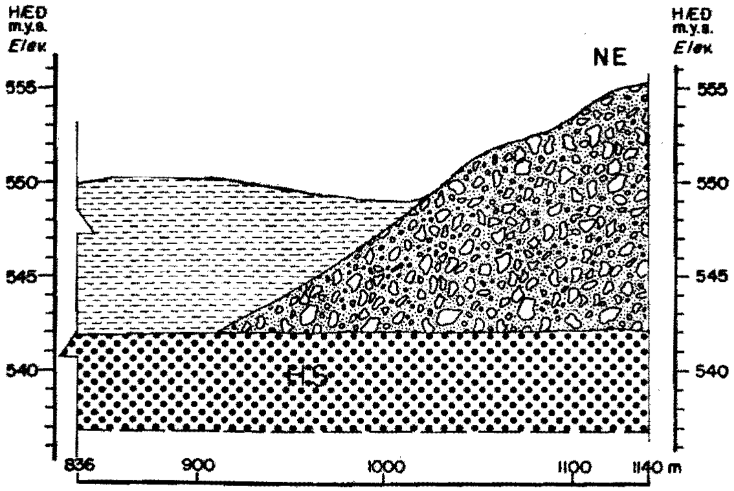
ORKUSTOFNUN	
GNÚPVERJAVIRKJUN Jarðlagasnið U – U *Geological section U-U*	
Okt. 72 Sv.Þ/Gyða Tnr. 52	Fnr.10839

Mynd 23
Exh. —



Stíflustæði í Kisu / *Damsite in river Kisa*

V-V

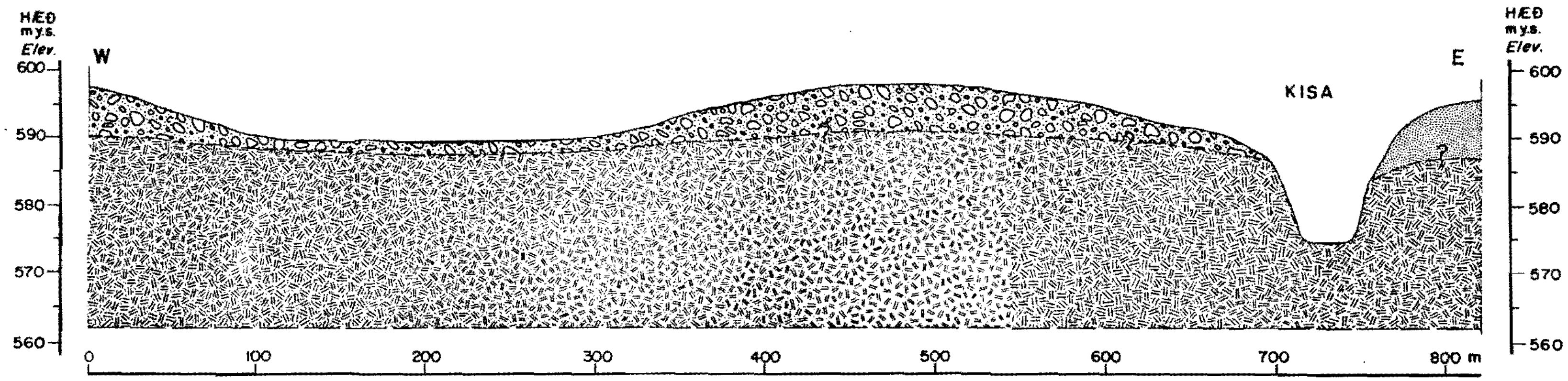


Staðsetning, sjá mynd 3
Location, see exhibit 3

Skýringar sjá mynd 25
Legend see exhibit 25

ORKUSTOFNUN		
GNÚPVERJAVIRKJUN Jarðlagasnið V-V *Geological section V-V*		
Okt.'72 Sv.Þ/eó	Tnr. 53 B-331	Fnr. 10840

Mynd 24
Exh. –"–



Efra stíflustæði í Kisu / *Upper damsite in river Kisa*

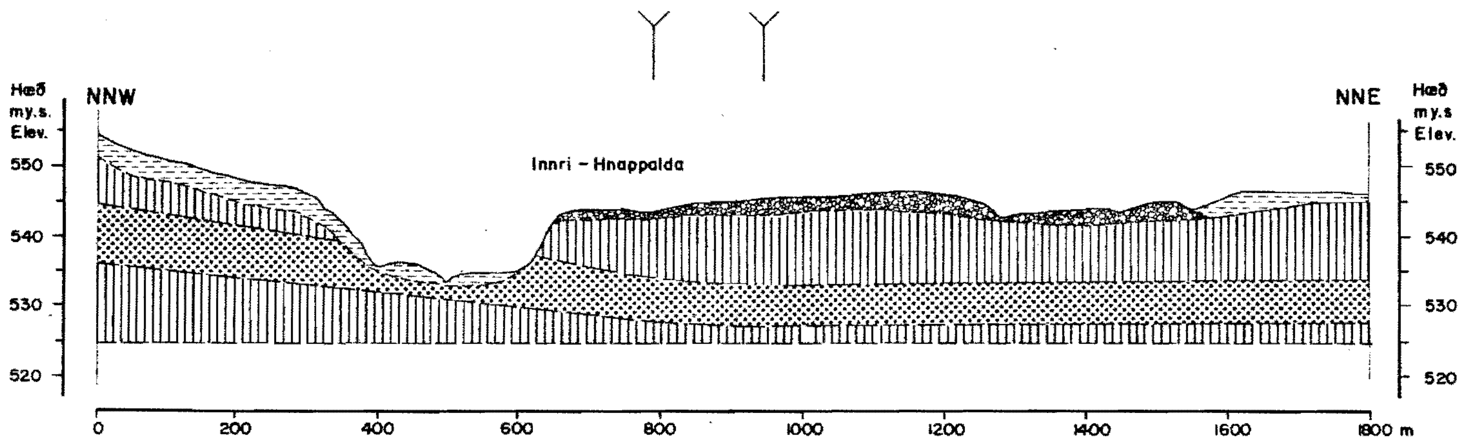
X – X

Staðsetning, sjá mynd 3
Location, see exhibit 3

Skýringar, sjá mynd 25
Legend, see exhibit 25

ORKUSTOFNUN		
GNÚPVERJAVIRKJUN Jarðlagasnið X – X *Geological section X – X*		
Okt. '72 Sv.Þ/eó	Tnr. 54 B-332	Fnr. 10841

Mynd 25
Exh. -"-



Stíflustæði við inntak
Damsite at diversion

Y-Y

SKÝRINGAR / *LEGEND*

- Basalt / *Basalt*
- Basalt, brotið / *Basalt, broken*
- Dílótt basalt / *Porphyritic basalt*
- Kubbaberg / *Cube-jointed basalt*
- HS Hvanngiljaset, völuberg / *Hvanngil sedimentary rocks, conglomerate*
- Setberg / *Sedimentary rocks*
- Jarðvegur / *Soil*
- Urð, melur / *Gravel, plain*
- Árset / *Alluvium*
- Jökulruðningur / *Moraine*
- Breksía / *Breccia*
- Malarás / *Esker*
- Y Snið beygir / *Section turns*
- – –?– – Óviss lagskil / *Uncertain contact*

Staðsetning, sjá mynd 3
Location, see exhibit 3

ORKUSTOFNUN	
GNÚPVERJAVIRKJUN Jarðlagasnið Y-Y *Geological section Y-Y*	
Okt.'72 Sv.Þ/eó	Tnr.55 / B-331 — Fnr.10842